A Potent Weapon Against Hackers

P. 88

FORTUNE

FORTUNE.COM

ISSUE: OCTOBER 1, 2015

OUR ALL NEW 40 UNDER 40 LIST

THE YOUNG REBELS RESHAPING BUSINESS

BET BIG

HOW JASON ROBINS OF DRAFTKINGS IS BLOWING UP THE $15 BILLION WORLD OF FANTASY SPORTS

By Daniel Roberts

P. 80

PLUS: THE BEST ADVICE FROM OUR RISING STARS

P. 109


YOU MIGHT NOT NEED IT.
BUT CAN YOU LIVE WITHOUT IT?
zoom-zoom


2016 MAZDA MX-5 MIATA | DRIVING MATTERS™
mazda


HITACHI
Inspire the Next

FORTUNE
Volume 172 Number 5

features

40 Under 40

ON THE COVER:
PHOTOGRAPH BY **WESLEY MANN**

THIS PAGE:
ILLUSTRATION BY **MATT TAYLOR**

FORTUNE *departments*

Volume 172 Number 5

Macro

Alek Wek in Intel-powered apparel

Tech

Invest

Visiting Trunk Club's New York City mansion

Passions & Perks

CORRECTIONS
A photo caption in "The Spy in the Corner Office" (Sept. 15) misidentified a General Dynamics shipyard. It is the company's Electric Boat shipyard in Groton, Conn. "She Thanks You for Not Smoking" (Sept. 15) stated incorrectly that Pembroke Consulting forecasts specialty drugs will soon generate 15% of pharmacy revenues; the correct figure is 50%.

Four Things I Learned From Our 40 Under 40

I RECENTLY passed my first anniversary as editor of this magazine and now feel entitled to have favorites among our annual franchises. Top of my list: 40 Under 40, which begins on page 69 of this issue.

It's not just the exuberance of youth that makes this group so compelling. It is the message they send about their generation and our future. They see no obstacle too big to overcome, no challenge that can't be met. Asked to define success, Will Ackerly says, "Solving intractable problems." Yehuda Shmidman answers, "Achieving the impossible." They accept no limits.

Some think their boundless enthusiasm may be the by-product of a speculative bubble. But these folks aren't buying it. "The economy is fundamentally changing as a result of massive technological shifts," says Noah Wintroub. Markets will wax and wane, but the revolution will continue, and these extraordinary people will be leading the way.

In preparing the issue, we have gotten to know a lot about this group. They have shared with us their management challenges, their best advice, their secret pleasures. From their wisdom I have come away with the following life lessons:

BET BIG. This is a group with high ambitions, and they are willing to take big risks to achieve them. "People always overweight risk," Sam Altman tells us. "Things are not ever as risky as they seem."

When asked to name the CEO outside their industry they most admire, one of two names most mentioned was Elon Musk—master of the big bet. James Park said he was "struck by the level of personal commitment and risk he has taken in starting Tesla and SpaceX."

HAVE A PURPOSE. In pursuit of their dreams, many of our 40 have achieved phenomenal financial success. But they say that's a side benefit, not the main goal. "Success is helping patients," says Michelle Dipp, who tells of a call she received from the parents of the first baby born with her breakthrough fertility treatment. Success means "being on a journey where I can positively impact the world and those around me," agrees Vas Narasimhan.

John Zimmer, meanwhile, credits Starbucks CEO Howard Schultz with the best advice he ever got: "Values matter; continue putting people first."

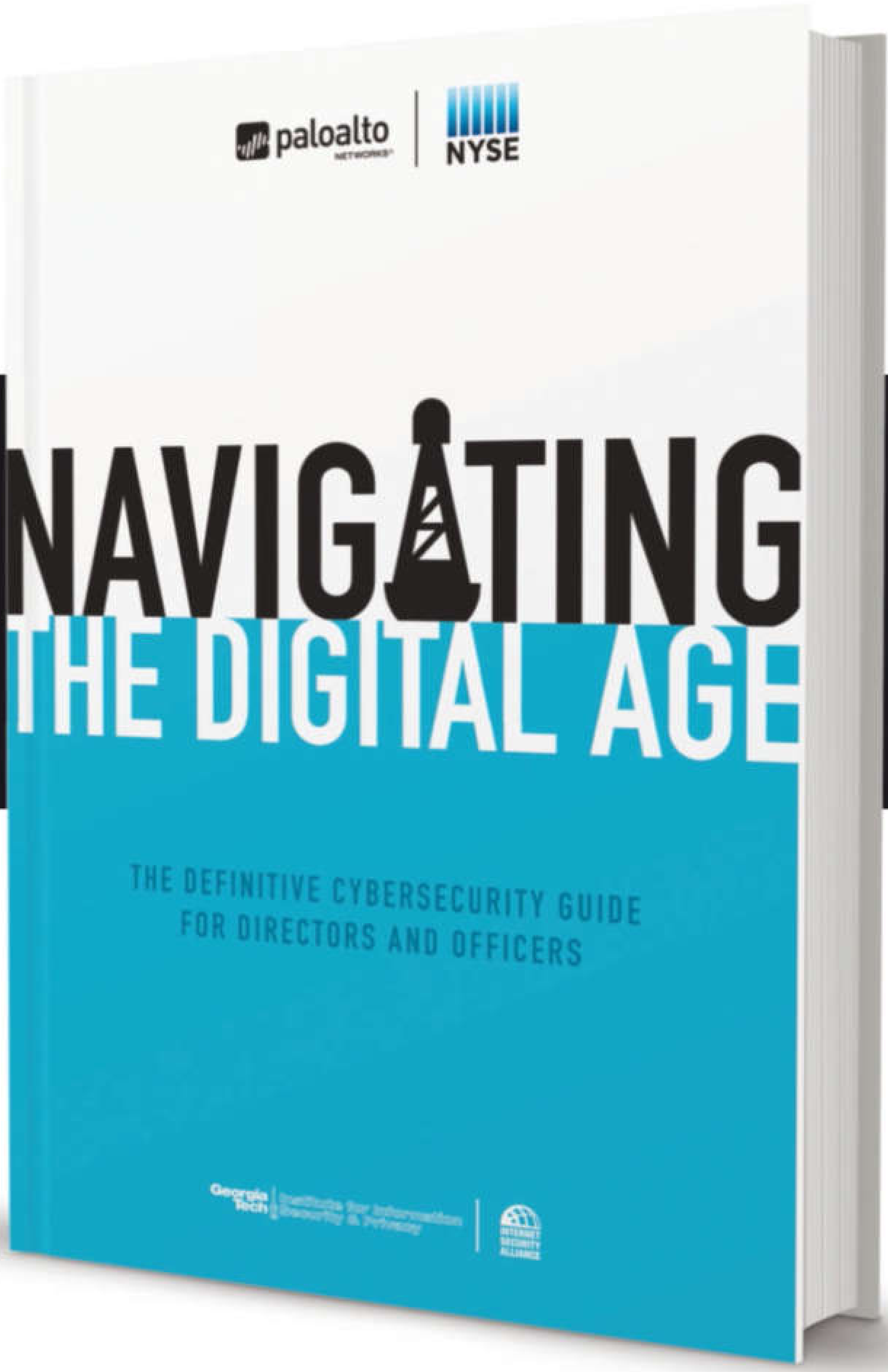
FAILURE IS A GOOD TEACHER. This Silicon Valley trope takes on deeper meaning in the lives of our 40. Instacart's Apoorva Mehta tells of quitting his job at Amazon and moving to San Francisco to become an entrepreneur. "I started and failed at about 20 different companies over a two-year period. Each failure wore away at my confidence and my willpower to continue. Had I failed a few more times, I'm not sure I would have had the tenacity to build Instacart." But looking back, he says, "those failures were an extremely efficient way to learn."

HAVE BREAKFAST WITH DAD. As the father of two daughters roughly her age, I particularly liked this offering from Taylor Swift:

"I think the best advice that I ever got as a teenager was to think about your actions. Because if you are 80 years old looking back, you know if your dad calls you at eight in the morning and wants to go to breakfast, as a teenager you are like, 'No, I want to sleep,' and as an 80-year-old looking back, you go to breakfast with your dad. It's just those little decisions like that."

ALAN MURRAY
Editor
@alansmurray

PHOTOGRAPH BY **WESLEY MANN**


paloalto NETWORKS
NYSE
NAVIGATING
THE DIGITAL AGE
THE DEFINITIVE CYBERSECURITY GUIDE
FOR DIRECTORS AND OFFICERS

GERMANY NEEDS MIGRANTS. DO WE?

The thousands of refugees fleeing Mideast conflict could change the face of Europe, and a growing body of economic research shows they might change it for the better. How an influx of migrants could become a blessing in disguise.

By Claire Groden

PHOTOGRAPH BY LAETITIA VANCON

T**HIS SUMMER** an unprecedented surge of migrants and refugees flooded into Europe, most of them Syrians fleeing a bloody five-year civil war. For those who managed to complete the arduous journey to the safer shores of eurozone countries, some were greeted by riot police, tear gas, and water cannons—and most by a populace generally terrified that their countries' economies and social systems would not be able to support a massive influx of the needy.

That is, except for Germany. In a break with its European Union counterparts, the country expects

to take in close to 1 million migrants by the end of the year—equivalent to about 1% of its population. Germany is betting that instead of causing fiscal chaos, the refugees will actually lift the economy.

There's ample reason to think Germany is right. The country's birthrate is the lowest in the world, and its workforce is rapidly aging. Because it takes resources to make the journey from Syria, many migrants who have successfully completed the voyage seem to be relatively young, well-educated, and well-off. "If we manage to quickly train those that come to us and get them into work, then we will solve one of our biggest problems for the economic future of our country: the skills shortage," Sigmar Gabriel, Germany's vice

Recently arrived migrants wait for buses at a train station in Passau, Germany, in September.

chancellor, told Parliament.

Of course, it will be costly too. Germany has earmarked nearly $7 billion for refugee costs this year. But if the migrants assimilate as quickly as they're expected to, that could eventually be offset by new taxes and higher consumer spending, says Demetrios Papademetriou, president emeritus of the Migration Policy Institute. The resettlement could play out the way it has so far in Turkey, where recent research shows a growing workforce and a demand for goods and services from Syrian refugees have boosted local business and created jobs. Or in Lebanon, where the World Bank reports that the influx of refugees, equivalent to a quarter of its population, has helped the economy outpace growth expectations, even as Syria's civil war has disrupted trade.

A large and growing body of evidence shows that accepting refugees is often economically savvy. In the U.S., where hostility toward immigrants is palpable this campaign season (witness the rise of Donald Trump), the country faces a looming wave of baby boomer retirements, which younger foreign workers could help offset with taxes, dollars, and productivity. (For more on the age wave, see next story.) Beyond that, immigrants start businesses twice as often as native-born Americans, they are disproportionately likely to work instead of collect unemployment, and—contrary to the campaign rhetoric—they aren't taking our jobs. A 2014 review that surveyed 27 studies globally on the topic found that while wages in some situations might suffer and others might improve, there was no overall depressing effect.

What's more, refugees can deliver even more of an economic boost than typical immigrants. According to one study, refugees who arrived in the U.S. between 1975 and 1980 were earning 20% more than other immigrants by 1990. And they may have additional motivation to excel, says Council on Foreign Relations senior fellow Ted Alden, because many feel they're getting a "second chance on life."

The U.S. recently upped its commitment to refugees, many of them Syrian, and will increase its overall refugee intake from 70,000 to 100,000 by 2017. The influx is likely to have a profound impact at the local level. In south St. Louis, abandoned and dangerous neighborhoods were turned into a vibrant "Little Bosnia" by thousands of Bosnian refugees in the 1990s. In Lewiston, Maine, the arrival of Somalian refugees restored the once ailing mill town's tax base and reversed its population outflows. And in Cleveland, a recent report found that the region's more than 4,000 refugees boosted the local economy by $48 million in 2012.

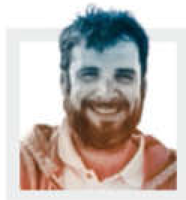
Of course, much of the impact remains unknowable, and there are still formidable challenges on all sides. As refugees, "you work hard, you put up with your lost status, and you still can't replicate the status that you had in Syria in the next three years," Papademetriou says. "But 10 years from now, you can do a hell of a lot better than you would have in Syria." That has upsides for the rest us too.

CAN PRIVATE CITIZENS HELP EASE THE CRISIS?

AS THE WORLD'S worst recorded refugee crisis deepens, governments have so far failed to solve the problem or stop the many deaths of people attempting safe passage out of war-torn countries. Enter executives with deep pockets and boardroom-tested outside-the-box thinking. Although even the greatest private fortunes would be hard-pressed to make a real dent in the scale of human suffering, with the EU and UN overwhelmed and cash-strapped, these businessmen argue they can help. More should follow their lead. —*Vivienne Walt*

JASON BUZI
REAL ESTATE INVESTOR

Buzi wants to create a new country for the world's displaced. The California developer announced his plan, "Refugee Nation," in July, estimating the cost at tens of billions. Possible locations include Indonesia and the Caribbean.



CHRIS CATRAMBONE
FOUNDER, TANGIERS GROUP

In 2013, Louisiana-based Catrambone and his wife bought an old expedition vessel in Norfolk and moved it to Malta, where it's now acting as a kind of private coast guard. The crew says the project has saved 11,000 from drowning.

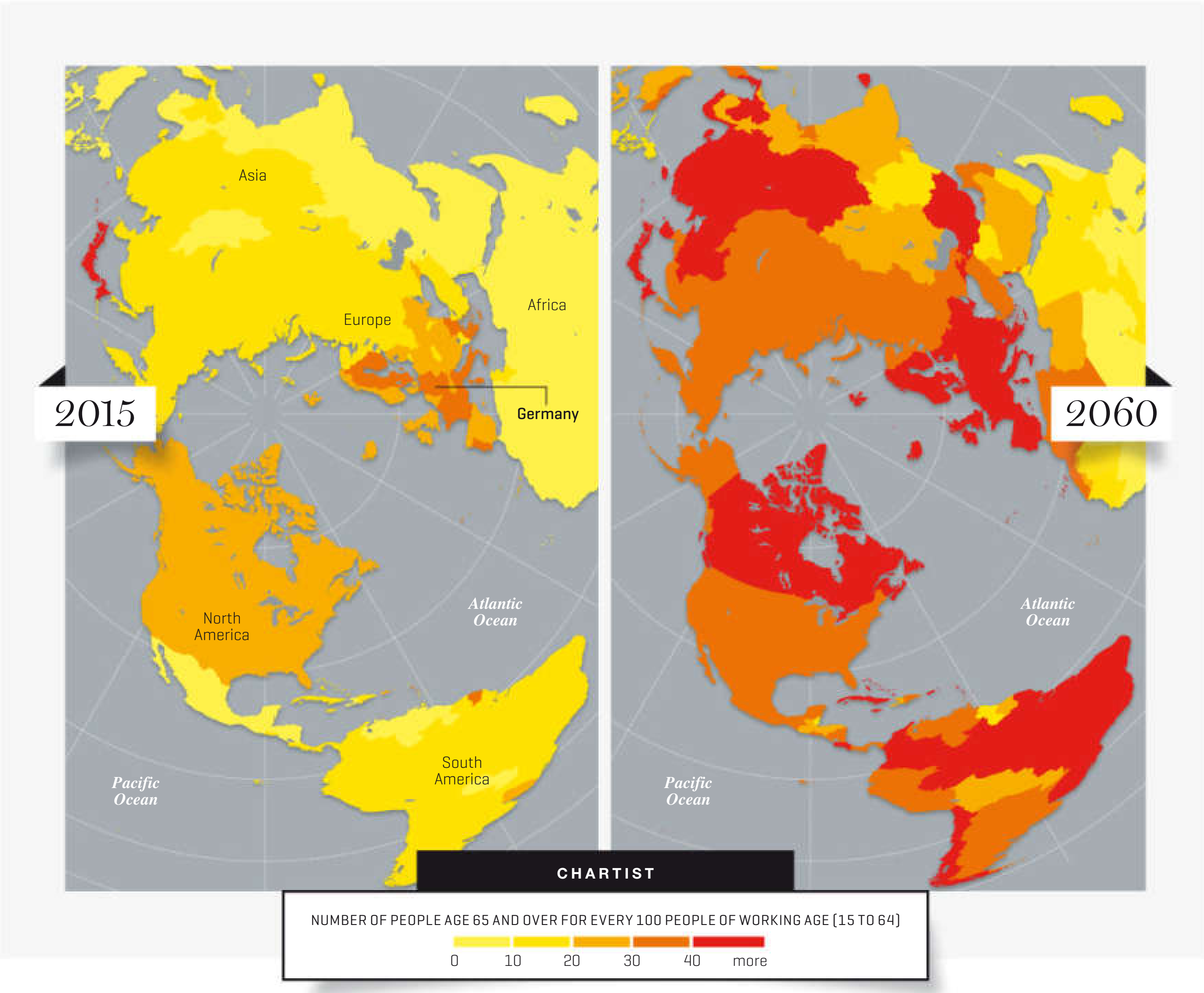
HAMDI ULUKAYA
CEO, CHOBANI

In May, Ulukaya pledged to donate half his $1.4 billion wealth to refugee aid. Because he grew up in Turkey near the Syrian border, the crisis hits close to home. "What I saw on the pictures is people I know," he said recently. "It is very familiar."

NAGUIB SAWIRIS
TELECOM BILLIONAIRE

The Egyptian mogul has reportedly taken steps to try to buy a Greek island to house millions of refugees. "Crazy idea maybe," he tweeted of the plan in September, "but at least temporary until they can return to their countries??!!"

PREVIOUS SPREAD: NEW YORK TIMES/REDUX; THIS PAGE: BUZI: COURTESY OF JASON BUZI; CATRAMBONE: COURTESY OF MOAS.EU; ULUKAYA: NEILSON BARNARD—GETTY IMAGES FOR NEW YORK TIMES; SAWIRIS: AMR ABDALLAH DALSH—REUTERS



The First World Is Aging

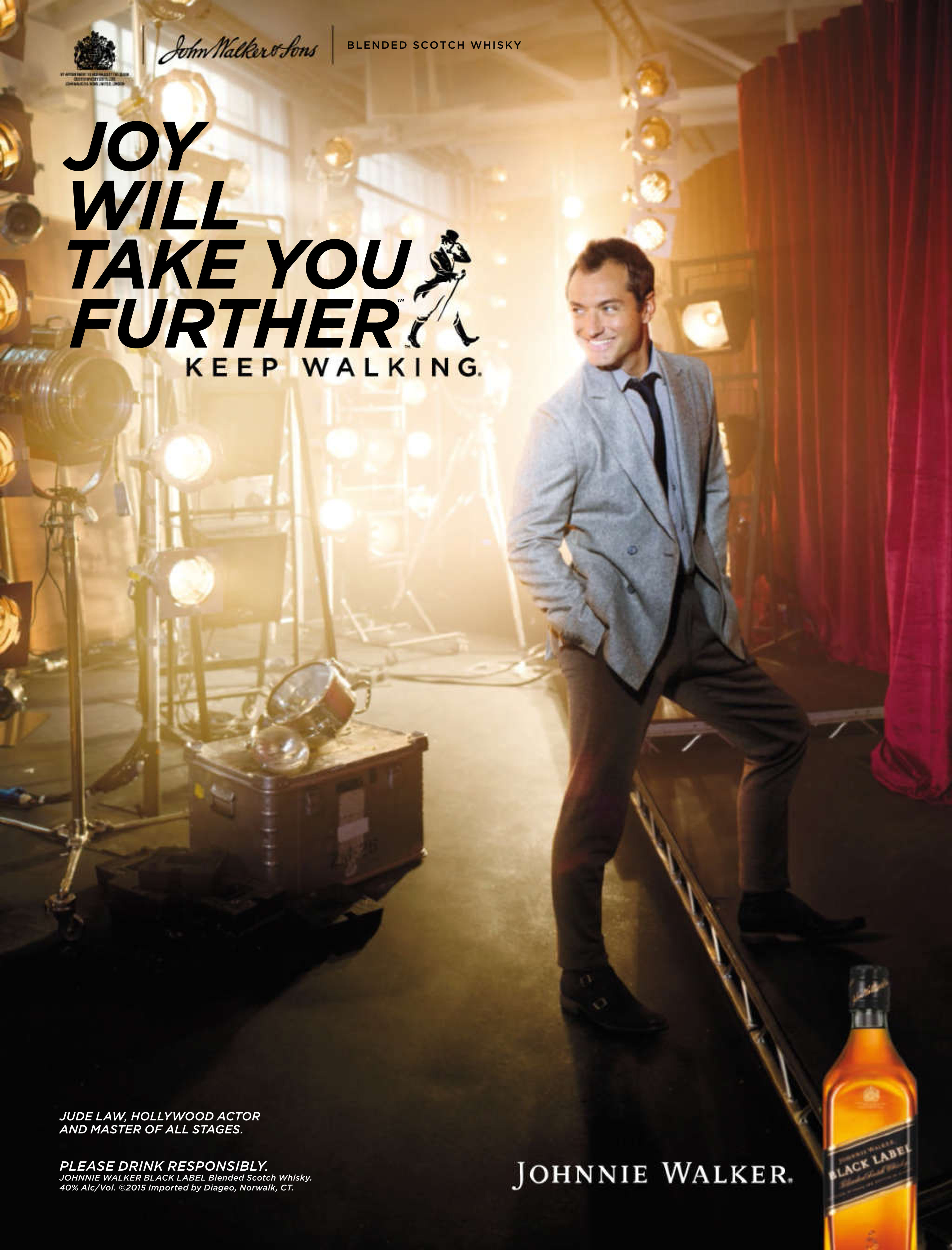
THE GROWING RANKS OF RETIREES IN THE DEVELOPED WORLD WILL STRAIN SOCIAL PROGRAMS AND WEIGH ON GROWTH. YOUNGER MIGRANTS MAY HELP EASE THE PAIN.

[redacted]

ACCORDING TO UNITED NATIONS estimates, by 2060, for every 100 people of working age, there will be 30 people who are 65 and older. That's more than double the ratio of old-to-young people today. Because of relatively low birthrates, the age wave is more acute in developed countries, where it will have a larger impact, increasing the cost of social programs and impeding economic growth. One solution: Allow younger migrants to join the workforce to boost productivity—and chip in taxes to support the elderly along the way.

GRAPHIC SOURCE: UN POPULATION DIVISION

MAP BY NICOLAS RAPP



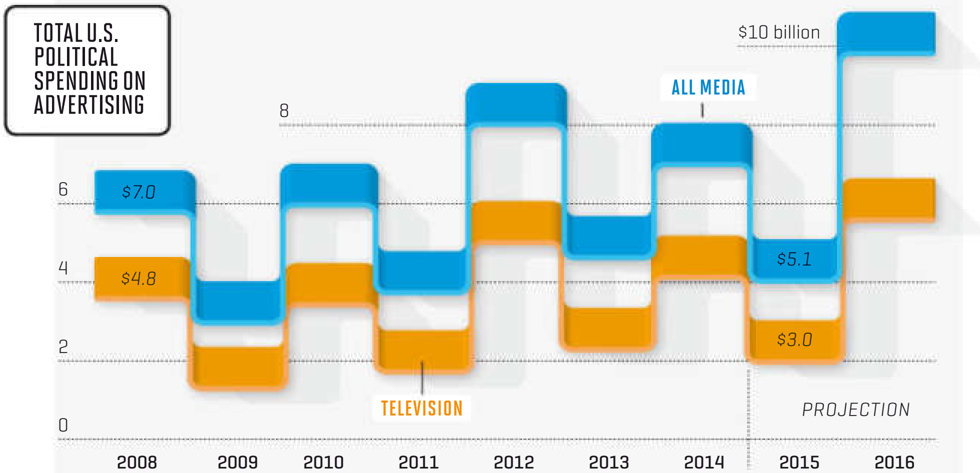
John Walker & Sons
BLENDED SCOTCH WHISKY
JOY WILL TAKE YOU FURTHER™
KEEP WALKING.
JUDE LAW, HOLLYWOOD ACTOR AND MASTER OF ALL STAGES.
PLEASE DRINK RESPONSIBLY.
JOHNNIE WALKER BLACK LABEL Blended Scotch Whisky. 40% Alc/Vol. ©2015 Imported by Diageo, Norwalk, CT.
JOHNNIE WALKER.
BLACK LABEL

GROWTH INDUSTRIES

TV and Super PACs: A Love Story

IF YOU'RE WORRIED about the deluge of outside money in politics, here's one small consolation: Big-spending Super PACs are getting a terrible deal on campaign ads.

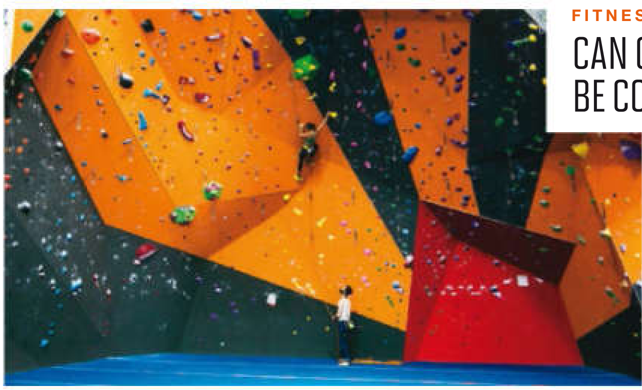
When candidates buy TV ads for themselves, federal regulations (not to mention scruples) often limit how much the station can charge. For outside groups, though, it's open season. "Who's going to go weeping for the Super PAC that gets gouged?" says Elizabeth Wilner of research firm Kantar Media. Right now Super PACs might pay triple what candidates do for the same airtime. As the election heats up, it may be 10 times standard rates, Wilner says.



VALUE OF CAMPAIGN AD AIRTIME BOOKED SO FAR

CANDIDATE	Marco Rubio for President **$16.2 million**	Hillary for America **$13.5 million**	Jeb 2016 **$400,000**	Donald J. Trump for President **$0** so far
SUPER PAC	Conservative Solutions PAC **$7.6 million**	Clinton's Super PACs seem to be holding their fire.	Right to Rise USA **$36.7 million**	Pro-Trump Super PACs exist but haven't booked ads.

That's good news for self-funded candidates like Donald Trump (if he ever runs an ad). It's even better news for TV stations. So far in the presidential race alone, while candidates have booked $35 million worth of ads, issue groups have booked $82.5 million worth, according to Smart Media Group's Pharo FCC-tracking platform, and the totals will continue to climb quickly. The priciest booking so far? Pro-Marco Rubio Super PAC Conservative Solutions' bid for a Super Bowl spot at $300,000. There's plenty more where that came from. *—Anne VanderMey*



FITNESS CRAZED

CAN CLIMBING GYMS BE COMMODIFIED?

In a world full of chains like SoulCycle and CrossFit, rock climbing may be the most relaxed of on-trend fitness obsessions. But there's controversy afoot in the bohemian business of belaying. Bulgarian company Walltopia, increasingly the industry giant, will debut a new product this fall that will standardize climbing routes using giant, mass-produced panels, making it possible for gyms to revamp walls without hiring pricey workers to plot out unique courses.

The new walls will enhance the $150-million-a-year climbing industry's ability to, ahem, scale. But not everyone loves Walltopia, which is set to open swanky new headquarters in Sofia and just signed a $50 million contract to build 30 to 50 walls in China.

While its innovations may make the sport more accessible, hard-core climbers bemoan its McDonaldization. Jeremy Ho, who designs rock courses in California for a living, says the new walls have all the originality of prefab Ikea cabinets. But, he adds, "I'm probably pretty biased because it's my career on the line."

—BRENDAN BORRELL

RUBIO: STEVE SANDS—WIREIMAGE/GETTY IMAGES; CLINTON: SCOTT OLSON—GETTY IMAGES; BUSH: JUSTIN SULLIVAN—GETTY IMAGES; TRUMP: DOUGLAS GORENSTEIN—NBC/NBCU PHOTO BANK VIA GETTY IMAGES; ROCK WALL: MINNOW PARK SOURCES: BORRELL ASSOCIATES, SMART MEDIA GROUP PHARO PLATFORM


John Walker & Sons
BLENDED SCOTCH WHISKY
JOY WILL TAKE YOU FURTHER™
KEEP WALKING.
JIM BEVERIDGE, WHISKY CREATOR AND SIXTH GENERATION JOHNNIE WALKER MASTER BLENDER.
PLEASE DRINK RESPONSIBLY.
JOHNNIE WALKER BLACK LABEL Blended Scotch Whisky.
40% Alc/Vol. ©2015 Imported by Diageo, Norwalk, CT.
JOHNNIE WALKER.
BLACK LABEL

RESOURCES

BIG OIL TAPS BIG DATA

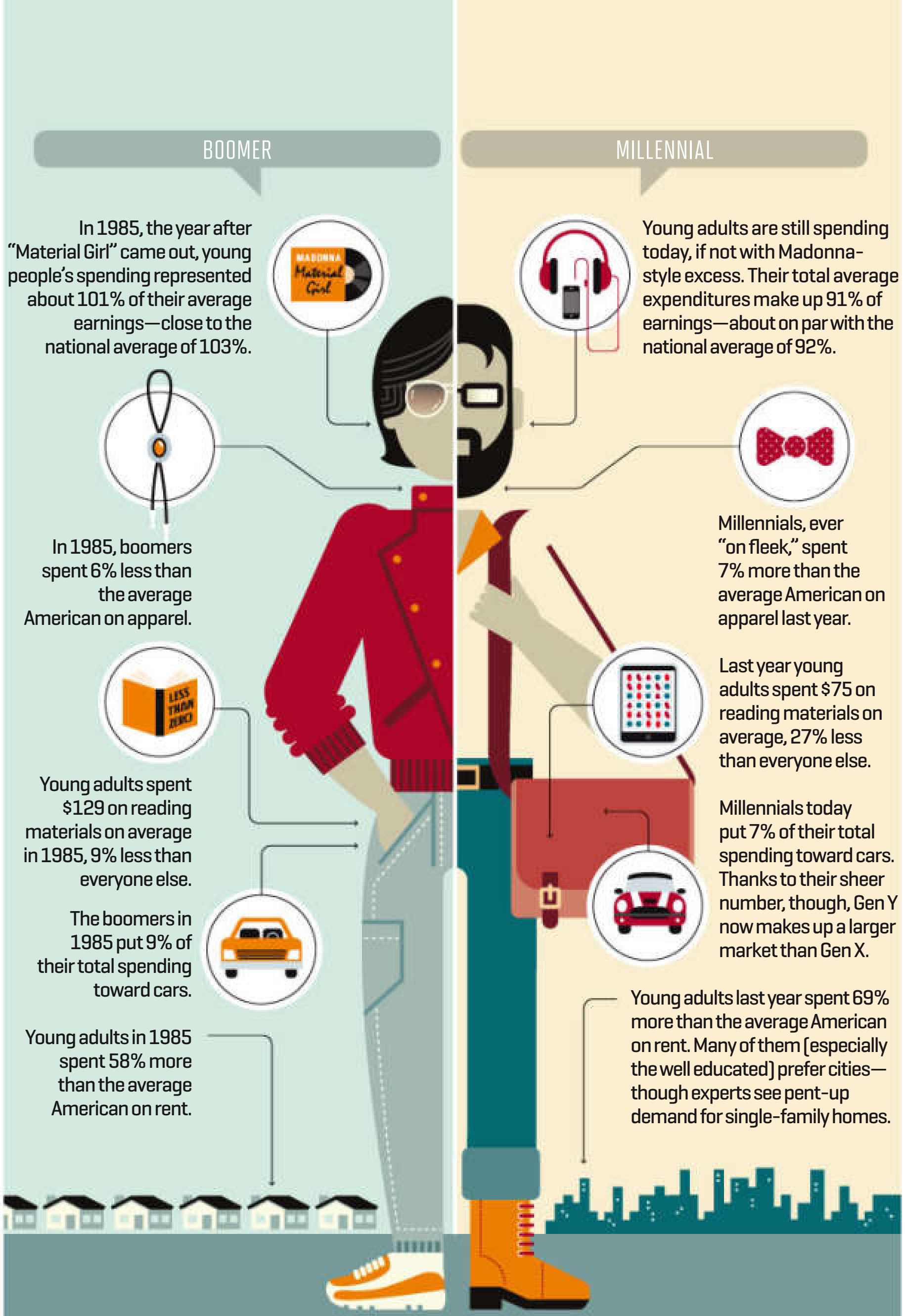
Plummeting oil prices have forced the world's largest energy companies to slash costs and increase efficiency. Enter big data. While oil companies have been putting billions of dollars into information technology for decades (BP operates what it says is the world's largest supercomputer for commercial research), the industry is now leaning on those investments to pay off. Here, a few of its biggest big-data bets. —*Katie Fehrenbacher*

1. **SENSORS ON EVERYTHING** From smarter pumps to drilling systems, sensor-laden hardware in oilfields is producing enormous volumes of information, which can be used to reduce downtime and increase automation.

2. **EVERY LAST DROP** New tech that measures sound and temperature is bringing transparency deep inside the well, letting operators adjust drilling based on where oil is flowing in real time.

3. **PREDICTIVE MAINTENANCE** Thanks to big data and machine learning, operators can estimate with increasing accuracy when an important and expensive piece of oil equipment will need repairs or replacement.

4. **BRING IN THE DRONES** When the view on the ground isn't good enough, companies can tap satellite data and even drones equipped with thermal imaging to monitor gear and flag leaks.



MY G-G-GENERATION

Millennials: They're Just Like Us?

We looked at the spending habits of young adults today compared with 30 years ago—when boomers were the same age as Gen Y is now. To make the comparison, we tracked the 25-to-34-year-old age group using numbers from the Bureau of Labor Statistics Consumer Expenditure Survey. The takeaway: Don't believe all the rumors you hear about millennial consumers, especially the ones that say they don't buy stuff.

OIL: GETTY IMAGES

ILLUSTRATION BY **HEADCASE DESIGN**

◀ Nationwide's booth at the National Black MBA Association conference

COURTESY OF NATIONWIDE

100 BEST COMPANIES TO WORK FOR

No. 95

Headquarters
Columbus

Revenues
$36 billion

Perk
Meetings with mentors help orient newbies during their first year.

GREAT WORKPLACES

NATIONWIDE'S ON-THE-SPOT HIRING

The mutual insurance company hires on-site at multicultural MBA conferences.

By Katherine Reynolds Lewis

JOHN DAVIS was a newly minted MBA when he wandered by the Nationwide booth at a job fair, attracted by the banner that read INFORMATION TECHNOLOGY. After a few minutes of chatting with an HR exec, he spoke with one of the company's chief technology officers, who scheduled him for a formal interview that afternoon. The next day he received an offer for a full-time job.

"I had no idea Nationwide was giving positions on the spot. I was so overwhelmed with the feeling of accomplishment," recalls Davis, who is now a business specialist in the company's business transformation office.

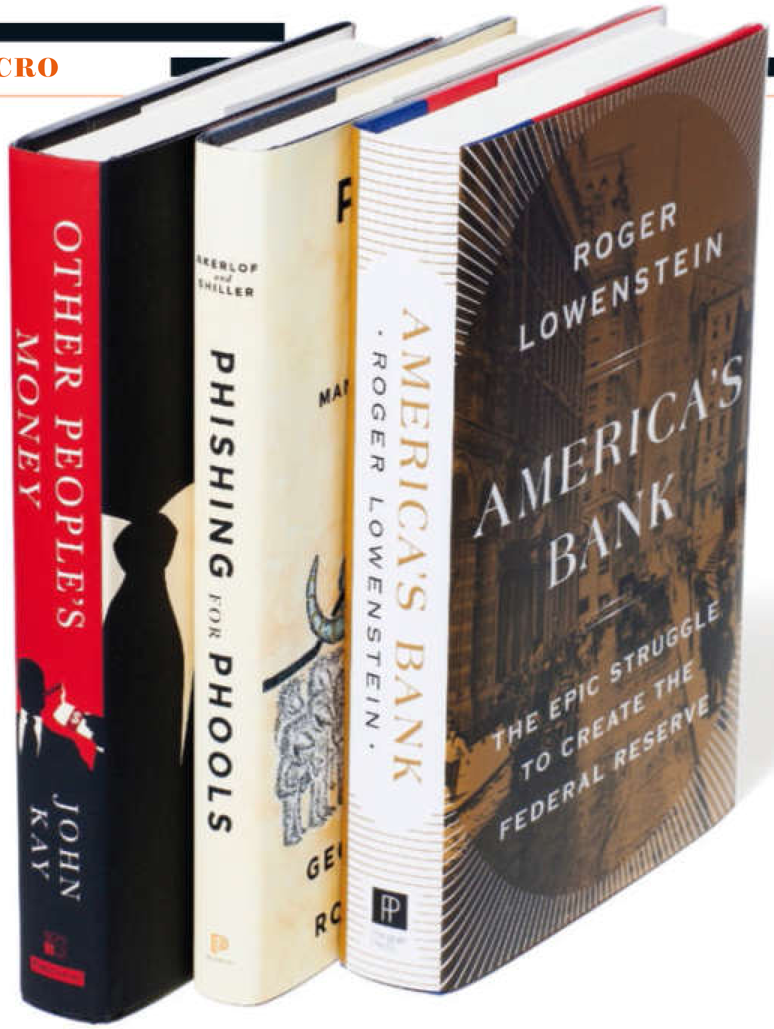
In an era when a job hunt can take weeks or even months, it's a radical notion to receive a job offer within days. Nationwide sends about 80 employees to the National Black MBA Association conference each year, including recruiters and hiring managers, and shows up in similar strength at conferences run by the National Society of Hispanic MBAs and the Anita Borg Institute (an advocate for women in technology). In 2013 the company filled 50 full-time jobs and 92 internships on-site at those three events. (About 45% of interns join the company full-time at the end of their internships.)

"We get a chance to look at some of the best and brightest," says Nationwide CEO Steve Rasmussen. "We want to tell them we're decisive about the kind of people we like and want to work with. It has been beyond our expectations as to what we would get out of this."

Nationwide is able to make swift hiring decisions by screening candidates before the conference. Recruiters review résumés, conduct phone interviews, and arrive at the event with targeted positions to fill and a list of skills in demand. That positions them to assess potential quickly and then make offers, which are contingent on successful background checks. "When I was able to see not only did he have the technical acumen, he also had a business presence and a great personality, it was enough to say, 'This is a person we want on our team,'" says Jermaine Henson, the Nationwide vice president who interviewed Davis that first day of the conference.

Company reps at these conferences include board members and executive vice president and chief administrative officer Gale King, who oversees HR. New hires can begin to build the relationships that Nationwide considers central to its culture.

At an evening reception the first day at the conference, King affixed a Nationwide pin to Davis's blazer in a not-so-subtle pitch for him to join the company. "I have an emotional connection to what that day was, to meet the people and smile with and eat with and talk with them. It solidified the type of culture within Nationwide," Davis says, noting that the people he met at the conference continue to be important in his day-to-day work. ■



EXECUTIVE READ

How Finance Works (and Doesn't)

WE REVIEWED THREE NEW BOOKS OUT THIS FALL FROM SOME OF THE WORLD'S FOREMOST ECONOMIC AND BUSINESS WISE MEN. EACH TAKES A FRESH LOOK AT THE FINANCIAL SYSTEM AND WHAT IT TAKES TO KEEP IT FROM BREAKING DOWN.

OTHER PEOPLE'S MONEY

BY JOHN KAY

Kay doesn't care what the markets think. "Any notion that traders have interesting insights into the formation of economic policy is quickly dispelled by the slightest contact with them," the U.K. economist writes in a typically droll paragraph in his devastating new book about the world financial system. The problem, Kay says, is that the industry represents a huge segment of the world economy, and yet its actual contributions to it are impossible to discern, thanks to a mind-boggling complexity that fosters instability and too often ignores the actual customers (you know, those "other people"). The solution, he argues, is not increased regulation, already too voluminous, but a rethinking of the entire financial order. With a flair for metaphor, Kay's occasionally academic prose is well worth the time. Wall Street, it's safe to say, will not like it. —*Anne VanderMey*

PHISHING FOR PHOOLS

BY GEORGE A. AKERLOF AND ROBERT J. SHILLER

The protagonist in the latest book from Nobel Prize–winning economists Akerlof and Shiller is a fundamentally good, endlessly engaging idea-generating machine. The character is also a treacherous and, at times, cruel huckster—the evidence of which grows with each passing page. This flawed hero is the free-market economy, and in this slim, readable volume, the authors make it come frighteningly alive. Building on rather traditional economic theory and behavioral finance, Akerlof and Shiller show how the same market forces that create opportunity also provide an opening (and incentive) for duplicity and fraud. And, it seems, most of us are only too willing to bite at the myriad schemes and bad deals being phished to us—from overhyped stocks to dangerous drugs to slippery politicians. No question, *Phishing for Phools* is a radical book. It may also be a radically important one. —*Clifton Leaf*

AMERICA'S BANK: THE EPIC STRUGGLE TO CREATE THE FEDERAL RESERVE

BY ROGER LOWENSTEIN

We're all Fed watchers today, nervously eyeing Janet Yellen & Co. as they manipulate interest rates to shepherd the economy. So it's bracing to be reminded that before 1913 the U.S. didn't have a Federal Reserve—or a unified banking system or even a uniform currency—and that consequently America was a global laggard, subject to constant economic panics that crippled businesses and farms. Depicting the effort to create a central bank, *Fortune* contributor Lowenstein tells a gripping tale with a trove of vivid characters and period details; you can almost see the handlebar mustaches and smell the oyster stuffing. And the broader cultural conflicts he describes—distrust of centralized authority, tension between Main Street and Wall Street—are just as relevant now as they were in the era of Taft, Teddy, and Woodrow Wilson. —*Matt Heimer*

PHOTOGRAPH BY MICHAEL CHINI

21ST-CENTURY CORPORATION

A MANUFACTURER GETS INVENTIVE

Flex built a huge global business around tech-industry outsourcing, but it sees a more profitable future in intellectual property and innovation. *By Adam Lashinsky*

REINVENTION IS THAT MOST elusive of challenges for an established corporation. Consider all the big U.S.-based companies that never reinvented themselves: Just 57 of the original *Fortune* 500, published 60 years ago, remain on the list today.

Flex, a $26 billion contract manufacturer known until recently as Flextronics International, is hell-bent on remaking itself—and not merely by clipping letters off its name. The company made its bones as an outsourced-manufacturing arm of gadget and IT hardware makers like Apple and Cisco, receiving and flawlessly executing customer designs. That's a big business, but it sports puny margins and includes low-cost competitors like Foxconn in China. So Flex has moved upmarket, refashioning itself as a "sketch-to-scale" engineering design shop.

Flex's 2,500 designers develop intellectual property both for Flex and on behalf of companies whose products it makes. At an innovation lab near its San Jose headquarters, for example, it shows clients designs for products like sensors embedded in fabric for "wearable" applications. Customers can send their own design engineers to the lab to noodle on how their ideas might mesh with Flex's wares, and Flex provides ultra-secure work areas where customers can pursue top-secret projects.

Flex's reinvention also involves its Lab IX accelerator arm, which makes venture capital type investments in startups that might become big buyers of Flex's manufacturing services. Examples include NextInput, a sensor company; Atheer Labs, a "3-D augmented reality platform"; and Muse, which makes a headband that monitors brain activity during meditation.

Flex has moved to spin out products that don't fit comfortably within a giant corporation. One promising example is the software Flex developed to organize real-time information from the company's vast supply chain. Flex uses it to follow goods flowing across multiple vendors, tracking where products are in transit and their expected arrival times. The software proved valuable to customers who use multiple manufacturers—including Flex competitors. So in 2012, Flex, along with VC investors, created a new company called Elementum to sell the software.

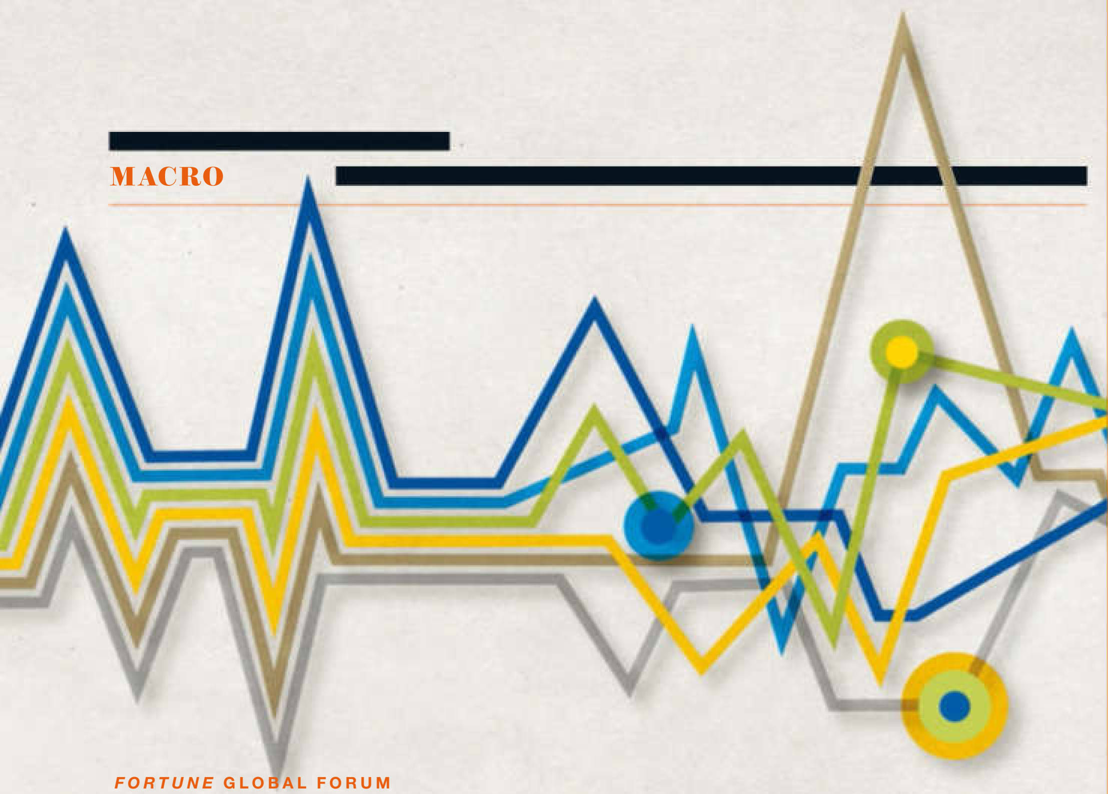
The startup, majority-owned by Flex, aims to fill a void Flex thinks Oracle and SAP, the top supply-chain software vendors, have left in the market. "The capabilities we created weren't unique to Flex," says Flex CEO Mike McNamara. "They were unique to supply chains."

Elementum CEO Nader Mikhail says the startup's customer base has expanded beyond the accounts it inherited from Flex, though revenues are modest. Flex's margins, meanwhile, have inched up to the 2% range, from around 1%, reflecting that the lion's share of revenues still comes from its existing business model. Reinvention is urgent, but it isn't necessarily speedy. ■

At left, a Flex supply-chain monitoring system in action; below, a Flex-designed jacket embedded with wearable biosensors

JACKET: JACK SINCLAIR—FLEX; PULSE CENTER: RICK ENGLISH—FLEX

MACRO



FORTUNE GLOBAL FORUM

THE BREAKUP OF THE GLOBAL ECONOMY

After years of "convergence," the world's biggest economies have stopped moving in lockstep. That's making life challenging for investors and managers. ***By Geoff Colvin***

JUST HOW ALIGNED is the global economy? To what extent is it one comprehensible system, as opposed to a lot of independently operating systems? Getting the answer right is crucial for anyone who wants to manage or invest wisely—and the answer seems to be changing.

Until recently, the world was looking like a big machine with all the parts turning in the same direction. At the surreal height of the last boom, in 2007, all the world's major economies and nearly all the minor ones were growing together at respectable or better rates. "Global fundamental economic conditions are nearly perfect and have been for some time," the insightful fund manager Jeremy Grantham noted wonderingly. Nothing like that had ever happened before. Then, in the financial crisis, nearly everyone plunged together. It looked as if the world's economies had truly converged.

But no more; just the opposite. The U.S. will grow a healthy 3.1% this year, with the U.K. close behind, says the IMF, while Germany and France will struggle to beat 1%. Or look at some of the BRICs nations: India is booming at 7.5%, but China is slowing, while Russia and Brazil are in deep recessions. Divergence is today's trend. "These developments may signal the return of country-level business cycles," say the authors of a new research report from McKinsey. In which case the strategies of businesspeople worldwide may need to be rethought.

By itself, divergence isn't necessarily a bad thing. Back when nearly all economies and markets seemed aligned, investment managers complained that "correlations are going to one"—meaning all asset classes were moving up and down together. Diversification was impossible; you had all your eggs in one basket, even if you bought a dozen baskets with a dozen different labels.

Less connected economies solve that problem, not just for investors but for corporate managers. Operating in a diverse array of markets, some healthier than others at any given time, can help smooth out a global company's profits. For example, the diesel-engine maker Cummins announced earlier this year that sales would fall in Brazil and China but that U.S. demand would more than compensate.

A disadvantage of divergence is that it makes life more complicated. Managers and investors need to understand more factors peculiar to each of many economies. The bigger downside: An increasingly divergent global economy is riskier overall. It's a world in which market-hostile economies haven't moved toward a market-based allocation of capital, which is more resilient to shocks. It's also a climate in which countries haven't worked out freer trade or agreed on policies for protecting intellectual property and regulating cross-border mergers. "A convergent world would not be impervious to shocks," say the McKinsey researchers, "but it would be better able to absorb them."

On balance we should probably root for convergence. Whether it happens is another question. The best advice for managers and investors is to do the classic scenario exercise: Imagine different futures, convergent and divergent, and think through the repercussions for strategy at three, four, or five levels. As we've learned in the past decade, we can't know which future is ahead. But we can be ready. ■

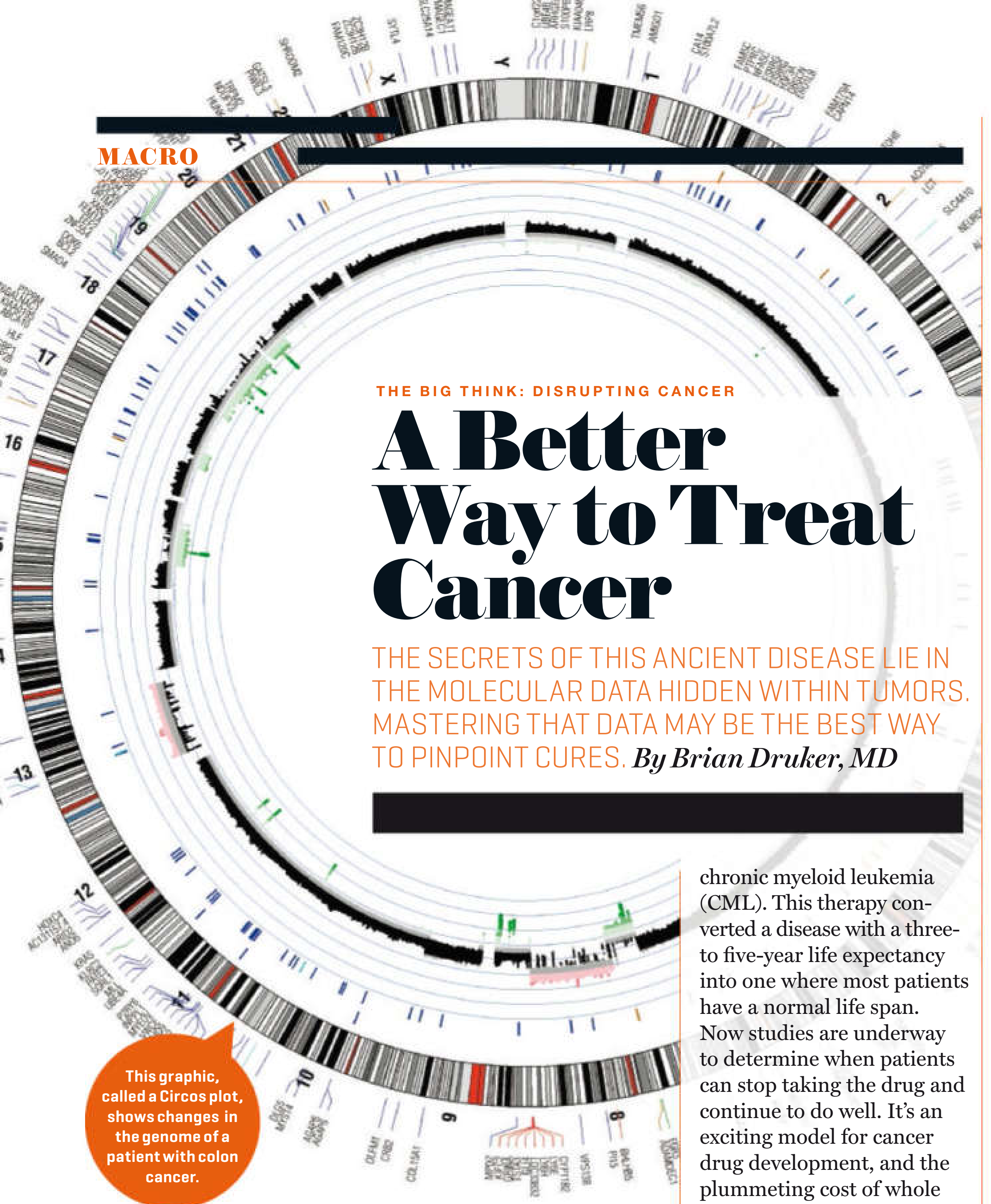
ILLUSTRATION BY CHAD HAGEN


Your HR team isn’t bad at finding the right people.
Your HR software is.
It’s not them. It’s your outdated bundled HR software. Successful talent acquisition now requires its own dedicated software suite with social, mobile, and video tools. iCIMS empowers your company to find, screen, and hire the right people. Faster. Get growing. Visit icims.com
icims®
© Copyright 2015 iCIMS, Inc. All rights reserved.

THE BIG THINK: DISRUPTING CANCER

A Better Way to Treat Cancer

THE SECRETS OF THIS ANCIENT DISEASE LIE IN THE MOLECULAR DATA HIDDEN WITHIN TUMORS. MASTERING THAT DATA MAY BE THE BEST WAY TO PINPOINT CURES. *By Brian Druker, MD*



This graphic, called a Circos plot, shows changes in the genome of a patient with colon cancer.

CIRCOS PLOT: COURTESY OF BMC MEDICAL GENOMICS

AS AN ONCOLOGIST whose life's work has been to develop tailored cancer treatments, I find it frustrating that most patients are still being treated without full insight into what is causing their disease to grow and spread. The five-year survival rate for all common cancers in which there is metastatic disease (spreading) is well under 50% with conventional treatments, and for some diseases, like pancreatic cancer, it is as low as 7%.

I led the clinical development of Gleevec, a targeted drug that stops a mutation that causes chronic myeloid leukemia (CML). This therapy converted a disease with a three- to five-year life expectancy into one where most patients have a normal life span. Now studies are underway to determine when patients can stop taking the drug and continue to do well. It's an exciting model for cancer drug development, and the plummeting cost of whole genome sequencing has and will continue to create more success stories in precision medicine.

But getting to the point where genetically tailored treatment is a reality for all patients requires a considerable reevaluation of how we share knowledge.

Today, for the few patients who are lucky enough to have their tumor genomes analyzed by sequencing, it can still take months of painstaking analysis—and tens of thousands of dollars—to find the mutations behind that cancer's growth and then determine an optimal treatment. Even when this is done, the genomic data alone is insufficient to determine how effective a recommended therapy will be.

A tech executive I met through my work at the Knight Cancer Institute at Oregon Health & Science University is a lucky, living prototype of what is possible with precision medicine. But his experience also reflects the challenges.

After 23 years of battling a rare and unidentifiable form of kidney cancer, Eric Dishman, the head of Intel's health care group, was running out of options. He was fortunate enough to have his DNA sequenced, but afterward it took another six months of shipping hard drives of the resulting data across the country for a team of oncologists, computer scientists, and data experts to devise a treatment plan based on his molecular makeup. Following that treatment plan, within months he was miraculously cancer-free and on the path to a kidney transplant that saved his life. The experience motivated Eric to reach out to me to find better ways to deliver precision medicine.

Intel and the Knight Cancer Institute are now united in challenging the global medical and technology communities to achieve cancer precision medicine for patients—in one day's time—by 2020.

Success would mean transforming how care is delivered so that treatment teams could analyze patients' cancer cells through genome sequencing and molecular imaging, and then tailor a precision treatment plan

within 24 hours.

Today, even at the most advanced cancer centers, this process is largely manual. It's fraught with a lack of standards and analytics tools and limited by scattered data pools. Making progress will require monumental improvements in clinical workflows, computing efficiency, and how research insights are shared.

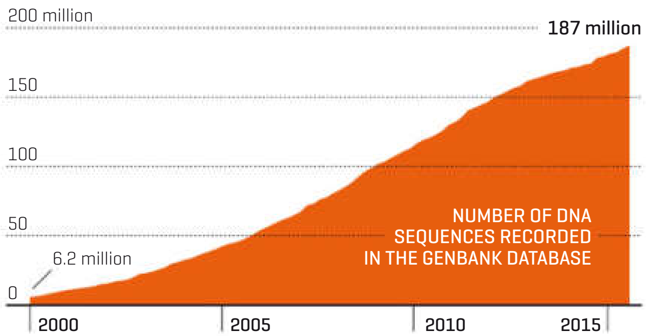
In large part, precision medicine is a data science. To maximize accuracy, doctors and researchers need to perform advanced computational analysis on massive data sets to discover which medication or combinations of medications will work best.

Celebrated success stories show the potential. A Washington University researcher's leukemia repeatedly relapsed and was resistant to treatment until colleagues sequenced his tumor DNA and found a key mutation that responded to a drug that put his disease into remission. A boy in Wisconsin had a mysterious brain infection; sequencing pinpointed an antibiotic that saved his life. A child's birth defect was completely unknown to science until his tech-savvy parents found similar cases around the world and mobilized genetic researchers to find a way to better control his seizure-like symptoms. Unfortunately, far too few people have access to or can afford these potentially lifesaving analyses.

As the cost of DNA sequencing continues to drop and molecular imaging becomes more commonplace, public and private databases with associated clinical outcome data will grow. These databases will consolidate the currently scattered pieces needed to complete the puzzle of identifying an individual patient's ideal treatment. These data sets are so large—sequencing one person's genome creates up to 1 terabyte of data, or the equivalent of 200,000 MP3 songs—that it is impractical to transfer them from one institution to another.

A MOLECULAR TIDAL WAVE

OUR UNDERSTANDING OF THE GENETIC BASIS OF LIFE (AND MANY DISEASES) HAS EXPLODED IN RECENT YEARS—SO HAS THE AMOUNT OF RELATED DATA.



SOURCE: NATIONAL CENTER FOR BIOTECHNOLOGY INFORMATION

To support the Knight Cancer Institute and Intel's "all in one day" vision, we developed a prototype collaborative cancer precision medicine platform capable of orchestrating this research across multiple institutions. This first-of-its-kind platform provides access to existing public and private computing clouds and standardizes research findings so that data can be more easily shared.

In contrast to traditional siloed approaches, our prototype is a distributed model, so medical centers can connect over a secure network to benefit from one another's data without moving it. This is important because it enables computation at each data site, with secure and anonymized results delivered back to the authorized requester. Each partner can maintain control of its patients' data, while the shareable cancer-treatment knowledge base grows, improving outcomes for patients around the world.

We launched a pilot of this system in August 2015 and will announce in the first quarter of 2016 that two other large cancer institutions will join us to extend capability. At this scale, doctors anywhere will be able to sit at their computers and access genomic and clinical data on millions of cancer patients, allowing them to design the best and most effective treatments for each. Eventually it will be possible to create collaborative precision medicine clouds for diseases such as diabetes, Alzheimer's, and autism.

Ultimately precision medicine will only be as precise as available data allows. To better understand complex diseases like cancer, the medical and tech industries must collaborate to make the growing wealth of public and private genetic data sets accessible for patient benefit. If we achieve success—and we will—we can turn a process that's agonizing and uncertain for countless millions of people into a predictable, highly tailored, one-day diagnosis and treatment recommendation. We may not be able to end disease in our lifetimes, but we can vastly improve our response to it.

Brian Druker, MD, director of the Knight Cancer Institute at Oregon Health & Science University, won a 2009 Lasker Award for his groundbreaking research in the treatment of chronic myeloid leukemia.

SEC chair Mary Jo White at the entrance to her Washington office. The sign to her left reads HOW DOES IT HELP INVESTORS?

GLOBAL POWER PROFILE

DON'T MESS WITH MARY JO WHITE

Some wish the SEC chief would crack down harder on Wall Street, but she's maintaining her reputation as a serious enforcer. ***By Geoff Colvin***

T

THE SECURITIES AND Exchange Commission attracts little attention except when there's financial trouble, and then it gets tons. Today the lingering trauma of the financial crisis is drawing plenty of notice to the Wall Street regulator—and to Mary Jo White, its chair since early 2013. In June liberal Senator Elizabeth Warren sent the 67-year-old White a blistering 13-page letter asserting that her "leadership of the Commission [had] been extremely disappointing." Rep. Elijah Cummings, a Maryland Democrat, likewise asked her to explain what he apparently considers the commission's too-gentle treatment of Citigroup, J.P. Morgan Chase, and other major banks.

With some measure of irony, White can blame her prior record of achievement for much of this criticism: She entered the SEC with a reputation for unrelenting toughness and prosecutorial vigor. In the 1990s, as U.S. Attorney for the Southern District of New York, a linchpin job in the Justice Department, she brought cases against Omar Abdel Rahman, the "blind sheikh," in the 1993 World Trade Center bombing, and other terrorists. In 1998, long before 9/11, she filed a sealed indictment of Osama bin Laden.

After that buildup it was probably inevitable that she would disappoint those who want her to apply the same iron hand to Wall Street. But in some ways she has indeed been more vigorous than her predecessors in pursuing financial wrongdoing. Last fiscal year the commission brought 755 enforcement actions and obtained orders for $4.1 billion of punishments, both record numbers. Early in her tenure she announced that, in certain cases, the SEC would settle charges against companies only if the company admits guilt—"a unique policy among civil law-enforcement agencies," she says. Such an admission is extremely painful to companies because it can expose them to substantial liability in private lawsuits. J.P. Morgan Chase, Credit Suisse, and other financial powerhouses have admitted wrongdoing under the policy, and White says the SEC has obtained more such settlements this year than in any previous year, including the first one with an accounting firm, BDO USA.

Like the penalties agreed to in settlements with companies, those involving individuals are not wrist slaps. "Many are barred from the securities industry or from being an officer or director of a public company," says White. "We're going to be relentless about any misconduct that occurs."

She also hints, diplomatically and accurately, that the SEC staff is stretched thin by jobs it didn't choose, like writing the recent rule ordering companies to figure their CEO's pay as a multiple of the median employee's pay. The Dodd-Frank law required the SEC to formulate that rule and almost 100 others. Asked about this latest one, she says, "We're very glad to get it done."

White has never shrunk from public attention. In light of the increasing scrutiny of the SEC, that's probably a good thing.

PHOTOGRAPH BY **SUSANA RAAB**


WE CAN HELP YOU SEE YOUR BUSINESS RISKS IN GREATER DETAIL.
The business you love deserves close scientific examination from our predictive analytics team. They have analyzed millions of claims to provide our claims professionals with distinctive risk insights. And by identifying the specific drivers that impact your company's risks, we can help you manage them better.
SEE OUR PREDICTIVE ANALYTICS VIDEO AT zurichna.com/pa
ZURICH INSURANCE.
FOR THOSE WHO TRULY LOVE THEIR BUSINESS.
ZURICH®

GOLF 2.0

ShotLink is changing the PGA TOUR® one stroke at a time.

EVERY WEEK ON THE PGA TOUR, as the world's top golf pros take aim at their targets, lasers take aim at them.

The lasers are components of the PGA TOUR's ShotLink System, an innovative platform for collecting and circulating scoring and statistical data on every shot by every TOUR player in real time. Powered by the TOUR's official technology partner, CDW, ShotLink was first introduced in 2001. It is now an integral part of the game, influencing everything from course setups to player strategy to how fans engage with TOUR events.

"At first glance, the information we gather might seem just like a dry collection of data," says ShotLink data analyst Luis Rivera. "But when you look closer, you see that it is so much more than that."

Rivera travels with the TOUR, and though he never steps onto a tee box, he is always at the center of the action. His workplace is a mobile bank of TV monitors and a trio of laptops nestled in a broadcast truck. The laptops are linked to ShotLink lasers, two of which are set up on every hole—one for the fairway, one for the green. Their infrared eyes follow every shot, recording the trajectory and the distance each ball travels to within a fraction of an inch.

Players rely on ShotLink data as they devise attack plans for specific courses and holes.

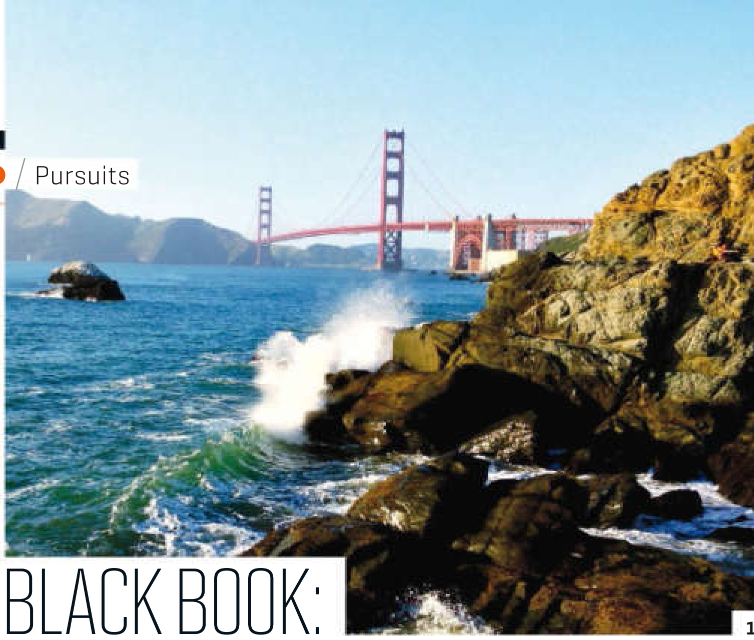
"The idea isn't just to regurgitate a bunch of information," Rivera says. "Our job is to pull out the most compelling threads and get them to the broadcasters, so they can get them out to the viewers at home."

ShotLink monitors 500 statistical categories, with more added each season. From their workstations, Rivera and his colleagues have ready access to troves of information on player performance, including advanced metrics like average distance to the flagstick on approach shots from 100 to 125 yards, or percentage of putts made from inside 10 feet.

"We have almost anything you can imagine," Rivera says. "Maybe you want to know how often a certain guy gets up and down for par from out of a bunker. Or how close, on average, he hits his pitch shots. All that information is coming to us live, updated automatically."

Many players rely on ShotLink data as they devise attack plans for specific courses and holes, determining where it makes sense to play aggressively, and which holes call for a laid-back approach. Likewise, tournament organizers mine the information as they decide on pin positions, fairway widths, and other elements of course setup.

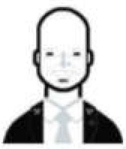
It's not just for players—ShotLink gives fans easy access to their favorite players' stats on PGATOUR.com and is repurposed for the broadcast booth as compelling infographics, which help broadcasters provide informed commentary and nuanced play-by-play. Thanks to some analytical ingenuity and a few lasers, golf has never been smarter.



1

BLACK BOOK: SAN FRANCISCO IN A DAY

You think you know San Francisco? Here are a few things you might have missed. *By Adam Erace*



JOSE LOPEZ is the chief concierge of San Francisco's Palace Hotel, which received a luxurious head-to-toe renovation earlier this year. "I love connecting with my guests and creating experiences for them," says Lopez, who leads a team of five concierges. Here are his recommendations for a perfect visit to the City by the Bay.

- **Best New Restaurant:** Al's Place is a charming new restaurant in the Mission from Aaron London. It's not flashy, and there are maybe 20 tables. The fries with barbecue sauce are sinfully delicious.

- **Toughest Dinner Reservation:** State Bird Provisions is a very small dim-sum place that is packed every night. If you can't get a reservation, bear in mind that the restaurant saves half the seats for walk-ins. Show up early, at four or five o'clock, and put your name down.

- **Under-the-Radar Museum:** The Asian Art Museum is in a space that used to be a public library and was redesigned by the architect who redid the Musée d'Orsay in Paris. Its rooms have natural light that shows off an impressive collection.

2

[1] San Francisco's many public parks offer a variety of activities. [2] Fare like this red trout with mandarin oranges draws crowds to State Bird Provisions.

- **Watering Hole:** I love Nopa. Its mixologists are innovative with their cocktails. My favorite is called Aperitivo de Jalisco. I love the fact that it is open late—it's where the hottest chefs in San Francisco gather after work.

- **Shopping Spree:** Al's Attire in North Beach is a fantastic shop that sells custom-made suits, dresses, coats, hats, and shoes. It takes a few weeks, so you'll need purchases shipped home.

- **Outdoor Activity:** There's so much to do at Golden Gate Park. I love the Japanese tea garden and dahlia garden at the Academy of Natural Sciences. At the top of the tower of the de Young Museum there are amazing views of the Golden Gate Bridge. You can go rowing at Stow Lake or rent bikes and cycle through the park to the Bison Paddock.

- **Locals' Secret:** To get a table at Lazy Bear, sign up online first. It announces availability a month ahead for the $125 prix fixe menu. It's like a dinner party, with cocktails and passed hors d'oeuvres before dinner.

- **Must-Have Souvenir:** For a perfect treat to tuck into your luggage, go to Dandelion Chocolate in the Mission. It does small batches, no blending, with beans from all over the world. You can see people in the back working on the chocolate when you go into the shop.

- **Things to Avoid:** Don't wait until the last minute to book an Alcatraz tour. Reserve tickets ahead of time (alcatrazcruises.com) or plan to wait in line at the box office for a limited number of daily tickets. Brokers charge inflated prices, so planning ahead is worth the savings.

THE $10,000 DAY

WE ASKED LOPEZ TO PLAN A SINGLE, SPECTACULAR DAY IN SAN FRANCISCO ... I would arrange for a carriage to take guests to the Embarcadero, where they would board a private charter boat to sail under the Golden Gate and Bay bridges on their way to the peninsula. Once docked, they'd take a scenic helicopter tour of the city before flying to Napa Valley to visit the finest California wineries. At lunchtime a coveted table will await them at Thomas Keller's famed French Laundry. After returning to the city they would be driven to Gump's, an only-in-San Francisco luxury store, where they could shop for the perfect keepsake, followed by a stroll along Market Street, then a stop at Meyerovich Gallery for a private tour of works by artists such as Picasso, Monet, and Matisse. Back at the hotel, our guests would indulge in an in-room massage, with cocktails and a late supper in a private dining room.

For a longer, interactive version of this story, go to fortune.com/blackbook.

GOLDEN GATE PARK: KEVIN KELLEHER—EYEEM/GETTY IMAGES; FOOD: DYLAN + JENI—COURTESY OF STATE BIRD PROVISIONS

ILLUSTRATION BY MARTÍN LAKSMAN

The author is measured by stylist Haley Clark in the John Varvatos room.

INSIDE THE TRUNK CLUB MANSION

A visit to the style retailer's hip New York space reveals a nirvana for the shop-a-phobic. ***By Christopher Tkaczyk***

BEING OUTFITTED by a personal stylist might sound like a dream come true. For me it's akin to a bad blind date. I'd first signed up for Trunk Club in 2013 and then spent weeks dodging the perky voice that kept calling and emailing me. Moments after answering questions online about my body shape, personal style preferences, and fashion habits (I wondered if this was a consultation or a confessional), I received a call from a woman named Barby. I found the quick response off-putting, so I didn't call back. But Barby called again. And again. She also emailed. I ignored all the messages.

The benefit of having a "virtual" stylist vanished as I realized that I would be forced to talk to an actual human being working on commission. I avoided Barby for the same reason I avoid personal trainers at the gym who roam the floor touting free training sessions: I don't like the inevitable sales pitch under the guise of advice. Trunk Club, a pioneer in the now-saturated online style-club marketplace, had crossed the imaginary line that made e-commerce easy and comfortable—the one that allows you to opt out of human interaction and shoddy customer service.

Now, two years later and faced with an assignment from my editor, I had no choice but to finally come face to face with a Trunk Club stylist.

The style club's New York City store is a six-story retail space that's equal parts showroom and social venue. Located on Madison Avenue, it takes up an entire wing of a former mansion that also houses the four-star Lotte New York Palace Hotel. Brian Spaly launched the online company in Chicago in 2009 after having co-founded Bonobos, another men's clothing startup that made

PHOTOGRAPHS BY DINA LITOVSKY

Trunk Club stylists choose clothes to match each customer's fit and taste.

a successful expansion from e-commerce to brick and mortar. Last year, Trunk Club was sold to Nordstrom for $350 million in stock, and Spaly remains CEO.

Since the acquisition, COO Rob Chesney says, Trunk Club's youthful, entrepreneurial culture has remained intact. It rolled out a trunk service for women earlier this year and continues to add new labels to its men's offerings. "It would have taken much longer to build a Trunk Club for Women without the Nordstrom relationship, which gives us access to a huge portfolio of women's fashion labels," Chesney says.

Trunk Club operates clubhouses in Chicago, Dallas, Los Angeles, and Washington, D.C., along with its newest location in New York, which employees have dubbed the Mansion. Trunk Club customers can make an appointment to stop by for drinks after work and meet with stylists to peruse the latest additions to the stock, which is updated every Wednesday. At any given time, its many fitting rooms are brimming with successful young prepsters willing to pay full retail for the hottest new designers.

WHEN I VISIT THE MANSION in mid-September, the receptionist greets me from behind a Chromebook. She's seated at a long plastic folding table—a makeshift front desk that will be replaced later in the week by a permanent fixture of wood and marble to match the decor. I notice blue trim tape lining some walls awaiting a fresh coat of paint. I ask for Dominique Dumais, whom I'm scheduled to meet for my style consultation. "I'll send her a G-chat," she says. A few seconds later she explains: "She's on her way. All of our stylists have moved into new offices around the corner on Park Avenue." Ten months after opening, Trunk Club has already outgrown its New York digs. A startup culture is still apparent.

Won't I please take a seat at the bar? I'm led to a room with long chesterfield sofas, which reminds me of the University Club just a few blocks away. I am tempted by the bottle of Macallan 18 at the end of the bar, but I opt for a black coffee. I am working, after all.

Dumais soon appears and gives me a tour of the 25,000-square-foot space, which opened in November 2014 and has taken almost a year to complete. Each of the 12 fitting rooms have interiors by different fashion houses, including Gant, Rodd & Gunn, Theory, DL1961, J Brand, and Vince. The John Varvatos room is decked out with black chandeliers, a silver piano, electric guitars, and a panoply of black-and-white photos of rock stars. A text message is sent to someone downstairs, and the Sonos sound system magically begins playing light rock. I'm digging it.

Dumais asks about my preferences. "No pleats. Ever." "Of course not," she agrees. I inquire about custom-made suits. A stylist named Haley Clark then takes my measurements and presents dozens of fabric swatches from Loro Piana, Gladson, and Dormeuil. Non-label shirts, pants, and suits are all made on site by a team of tailors. Prices for suits are $850 and up, depending on fabrics and cut, which is a low price point for a bespoke suit. However, she warns me, "sometimes they can reach $10,000 or more." A bit too rich for this journalist.

When Dumais wheels in a rack of ready-to-wear clothes in my size, I am not instantly thrilled by the selections. But I reluctantly try on everything. A gorgeous blue linen blazer from Ralph Lauren Polo fits me perfectly but carries a hefty $900 price tag. An Eton shirt with a fun pattern of tiny whales is too baggy, so I pass. After trying on a pair of mustard khakis from Paige, Clark sees me grimace and says what I'm thinking: "They don't do anything for your ass." Having a flat backside, alas, is a family trait.

At the end of my two-hour visit, I have picked out a pair of Paige denim pants ($179), a Velvetmen long-sleeve henley ($98), and a green V-neck Jeremy Argyle sweater ($158). Total bill: $435, which is more than my budget, but at Trunk Club—as at its competitors—you're paying for premium brands not carried by most department stores. There are no markups or markdowns. The Trunk Club curates items that it acquires through relationships with its vendors. If I choose not to buy anything, there's no cost—shipping and returns are free.

Given the many options for online stylists, is Trunk Club worth the price? For me, there's value in receiving honest opinions in person, something rare in retail—and a service that you can't find online. (And Barby, if you're reading this, it wasn't you. It was me. Amazon ruined me.)

Having a personal stylist takes the pain out of the hunt for the perfect outfit. With Dumais in my contacts list, I may never need to go online shopping again.

To see how TRUNK CLUB stacks up to competitors FIVE FOUR, BOMBFELL, FASHION STORK, and MEN'S STYLE LAB, visit ***fortune.com/styleclubs.***

Stresa, Italy
Fashion's "It Girl" Sylwia Zapora sports a silk dress as she steps out of the **Maserati Quattroporte**, featuring the world's first silk automobile interiors.

Photographed by Anders Overgaard Supported by INGLOT Cosmetics

FORTUNE, FASHION & FAST CARS

The Maserati and Zegna teams introduced the first ever silk interiors for cars, crafted with premium Italian leather, in the **2016 Maserati Quattroporte** and **Maserati Ghibli**. Each is custom made in Italy with its owner's name stitched on the sun visor.


PROGRESSIVE
COMMERCIAL
1-800-PROGRESSIVE
PROGRESSIVE.COM
FLORIST
FLO
COVERAGE THAT KEEPS YOUR BUSINESS MOVING FORWARD!
NOW WITH AWESOME CUSTOM COVERAGE!
BUSINESS INSURANCE
COMMERCIAL AUTO INSURANCE
SPEEDY CLAIMS
COLLECT THEM ALL!
FOR USE WITH ALL MIDSIZED COMMERCIAL VEHICLES!
PROGRESSIVE
PLANT FOOD

Tech

OBJECT OF INTEREST

WEARABLE. WIRELESS. WEB-READY.

(NO, NOT THE HELMET CAMERA.)

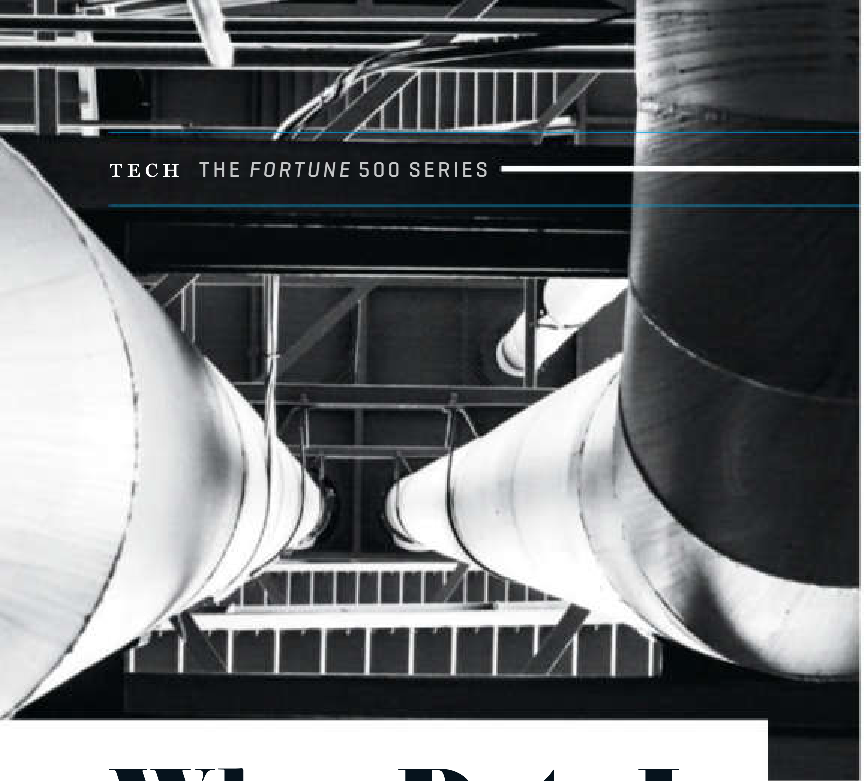
Supermodel Alek Wek smiles at New York Fashion Week.

DANIEL C. SIMS—GETTY IMAGES; INSET: COURTESY OF INTEL

Chromat Aeros Sports Bra

WHAT: A high-tech undergarment that walked the runway at New York Fashion Week. UNDERWIRED: Embedded in it are Intel Curie chips, tiny circuits packed with motion sensors, wireless radios, and battery-charging abilities. SMART SUPPORT: Triggered by changes in the wearer's perspiration, respiration, and body temperature, the garment's electronics adjust built-in vents made of a shape-memory alloy to warm or cool the wearer. ACTIVEWEAR: Global spending on wearable tech could total $19 billion by 2018, per Juniper Research. "Fabric is challenging," says Intel vice president Ayse Ildeniz. "It must be washed. It's price sensitive." SWEAT EQUITY: Having missed the mobile revolution, Intel hopes Curie will help it ride the next computing wave. "How do I make sure your smart shirt works with the other tech you're wearing?" Ildeniz asks. "Standards, interoperability—to technologists, that's incredibly difficult." —*Andrew Nusca*

TICKER TAPE *A collection of curiosities* / **EC1V** THE DENSEST U.K. POSTAL CODE FOR TECH FIRMS ("SILICON ROUNDABOUT" IN EAST LONDON) / **$17.2 BILLION** *Estimated value of 3-D printing industry by 2020*



When Data Is Cold Comfort

THE RISE OF INTERNET CONNECTIVITY AND CHEAP SENSORS IS TRANSFORMING HOW **EMERSON** SELLS HVAC EQUIPMENT. NOT EVERYONE WELCOMES THE CHANGE.

By Stacey Higginbotham

FOR THE PAST DECADE Charlie Peters has been trying to figure out how his 125-year-old manufacturing company will adapt to a world saturated with sensors.

Peters is an executive at Emerson, the Missouri electrical equipment giant. His employer is known for making valves for gas pipelines, compressors for air conditioners, and quite a few sensors of its own. What it's less known for is making money from selling the data that those components create. But that's exactly the kind of business Emerson increasingly wants to be in.

The corporate world is grappling with a future where an estimated 30 billion devices will be Internet-connected by 2020. Those devices are expected to create exabytes of new data—a torrent of potentially valuable information that threatens to forever change how companies like Emerson make money.

So Emerson is taking steps toward new business models that emphasize the value of the information, rather than the object it's attached to. A sign of that transition was on display at the Atlanta Home Show in September. There, Dan Jape, CEO of Reliable Heating & Air, a local home contractor, pitched a new Emerson service to the show's attendees called ComfortGuard. It required the installation of $100 worth of sensors in the AC unit, furnace, and ducts; a small wireless device that connects to the home's network; and software. With it, a homeowner could get a complete picture of his home's heating and cooling.

In exchange for that visibility—plus reminders to change filters and warnings of imminent part failure—Emerson charges $8 to $10 a month, in one of several models, for what amounts to preventive maintenance. It's a small price to pay, the company argues, compared with the hundreds of dollars one could shell out when an HVAC system breaks down in the middle of the summer.

Emerson's grand plan is to create a "platform" for home air conditioning, Peters says. It doesn't want to sell you a thermostat or an AC unit. It wants to sell you a comfortable environment.

It's a novel idea. But "adoption is not happening like we hoped," Peters concedes. Homeowners seem to like the technology, but smaller contractors have been reluctant to adopt it because it wrings out the inefficiencies in their own business—repair calls that result in little maintenance and lots of revenue.

"The barriers to adoption are much more severe than the barriers to develop the technology," Peters says.

For large contractors like Reliable—Jape employs 350 people, far more than the industry average of 10—the benefits are considerable. In peak season Jape can receive 1,500 repair calls in a day. With more data he can better allocate technicians.

Emerson continues to tinker with its approach. Jape is cautiously hopeful. "I've been in this industry since I was 13 years old," he says. "I've seen it change dramatically."

SNAPSHOT

Emerson

No. 120

Headquarters
Ferguson, Mo.

Employees
135,000

Revenues
$24.5 billion

CEO
David Farr

Founded
1890

Data analysis is changing the business of heating and cooling.

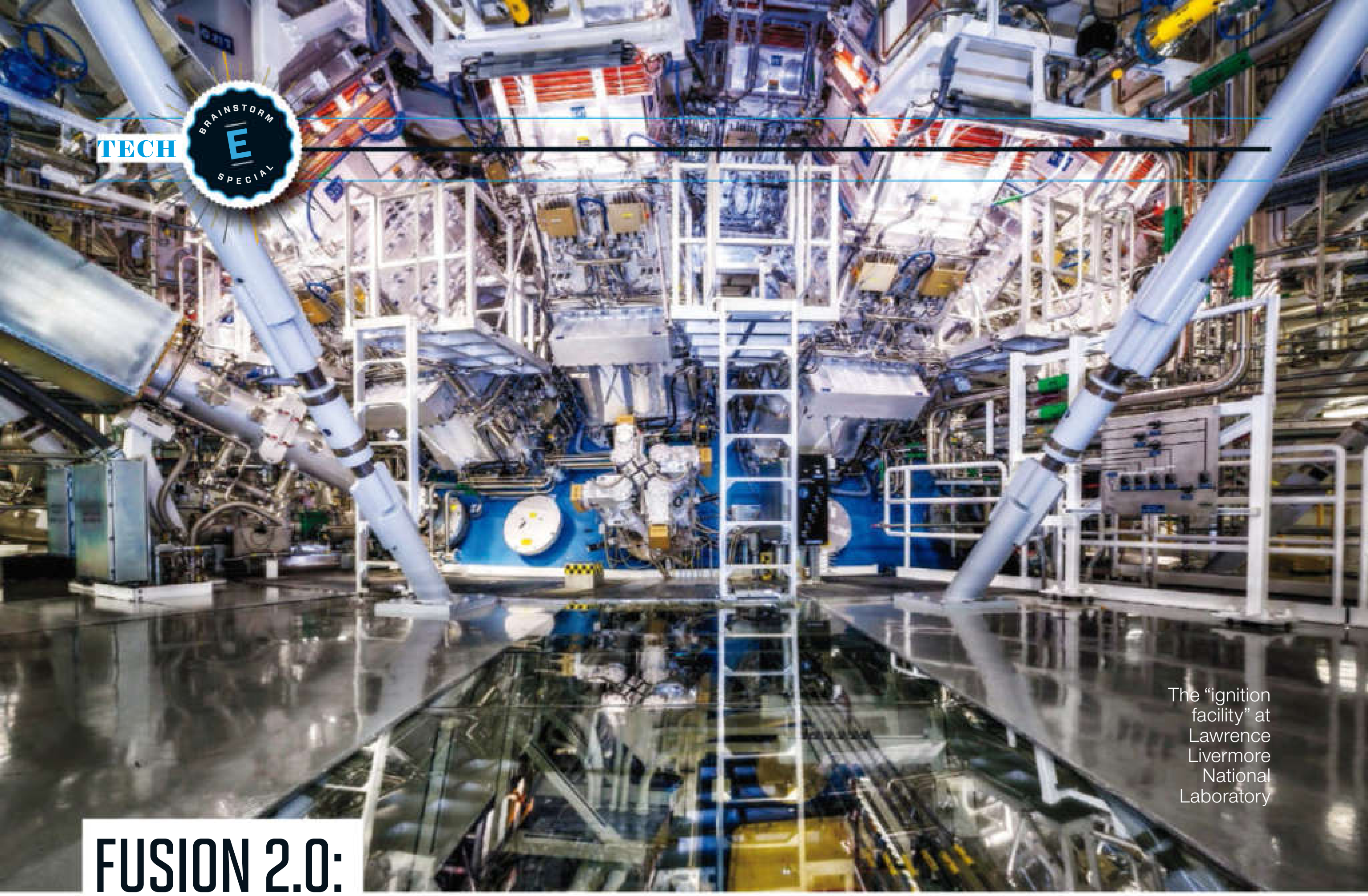
10,000 **Number of vehicles U.S. DOT will outfit with "V2V" connected-car tech for pilot project**

300% *Predicted revenue growth for ad-tech firms by 2020*

RAINER MOOK—EYEEM/GETTY IMAGES

This cloud
redefines winning.
The Microsoft Cloud gives Special Olympics instant access to key performance and health data for every athlete, no matter where they are. Microsoft Azure and Office 365 help streamline the management of 94,000 events across 170 countries each year. So the focus can be on changing the lives of athletes, and that's the true victory.
This is the Microsoft Cloud.
learn more at microsoftcloud.com
Microsoft Cloud

Billions of dollars in technology to combat the most mind-boggling conundrum of all: flats vs. pumps.
UPS for e-commerce. Online shoppers know they have plenty of options. Try it on. Don't like it. Send it back. Repeat. And with 67% of online shoppers* more likely to buy from a business that has a good returns policy, more and more retailers are relying on UPS to manage it all. We offer everything from simple online tools that streamline your returns to off-site warehouses that manage exchanges for online retailers around the country. And with easier returns, your customers will keep coming back. From figuring it out to getting it done, we're here to help. ups.com/solvers
ups united problem solvers™
*UPS Pulse of the Online Shopper™ Survey
Copyright ©2015 United Parcel Service of America, Inc.



The "ignition facility" at Lawrence Livermore National Laboratory

DAMIEN JEMISON—LLNL

FUSION 2.0: The Entrepreneurs Attack

Governments have failed to make the tantalizing energy source a reality. Now companies backed by JEFF BEZOS, PETER THIEL, and PAUL ALLEN think smaller scale can bring new success to an old idea.
By Brian Dumaine

FOR MORE THAN half a century governments around the world have been trying to solve the challenge of nuclear fusion. In theory it could provide a cheap, clean, and almost boundless source of energy. Consider this: One tablespoon of liquid hydrogen fuel—a mix of deuterium and tritium—would produce the same energy as 28 tons of coal.

But smashing two hydrogen atoms together at 100 million degrees centigrade to create a fusion reaction has proved to be a costly and elusive endeavor. The ITER international project in France has been plagued by cost overruns—the original 5-billion-euro project is now budgeted at 13 billion euros (about $15 billion)—and its 23,000-ton Tokamak experimental reactor, three times heavier than the Eiffel Tower, is still many years from completion. In the U.S. the Department of Energy's $4 billion Lawrence Livermore project, which uses lasers to smash atoms, is still deep in the experimental stage. Scientists are learning much from all this tinkering, but experts say these big projects—if they work—are at best decades away from commercialization.

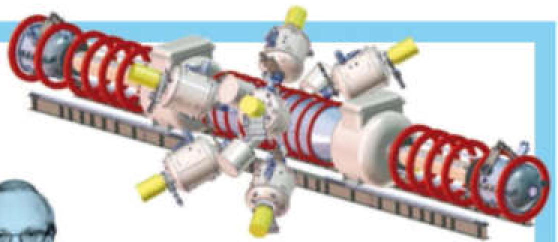
That's not soon enough if the world wants to mitigate the worst effects of climate change while providing cheap, clean energy to the poor—a point not lost on a handful of American billionaires including Jeff Bezos, Paul Allen, and Peter Thiel. These men are betting that fusion done on a small scale will be cheaper, less complex,

8.4% *Growth in Minnesota tech jobs over the past six months (California: 3%)* / **1/4** **Global energy reduction achievable by 2030, according to renewable-energy advocates**

BILLIONAIRES INVEST IN FUSION

> **JEFF BEZOS** General Fusion uses high-tech hammers to try to trigger fusion.

> **PETER THIEL** Helion Energy is working on a truck-size fusion reactor.



> **PAUL ALLEN** Tri Alpha made a breakthrough on small-scale fusion.

and ready for market sooner than the big government projects. Some major corporations, such as Lockheed Martin and General Atomics, have the same idea and are working on their own versions of small-scale fusion.

America has six private-sector fusion projects underway, according to a new report by the research firm Third Way. PayPal co-founder and Silicon Valley investor Peter Thiel has backed Helion Energy of Redmond, Wash. Microsoft co-founder Paul Allen has put money behind Tri Alpha Energy in Irvine, Calif., which has reportedly raised $140 million. And Bezos Expeditions, the investment fund of Amazon CEO Jeff Bezos, is backing a Vancouver company called General Fusion, which so far has raised $94 million.

Other well-heeled investors are sniffing around a different but related technology: cold fusion, which requires a much lower operating temperature. Skeptics will recall researchers Stanley Pons and Martin Fleischmann, who claimed in 1989 to have achieved fusion in a simple tabletop machine at room temperature. Their experiment was eventually debunked.

More recently scientists have been making some progress on a variation of this technology called low-energy nuclear reaction. That has led investors like Tom Darden, CEO of the $2.2 billion Cherokee Investment Partners, to create a North Carolina startup named Industrial Heat, which licensed the technology of Italian scientist Andrea Rossi. Last year Bill Gates visited the cold-fusion facilities of the Italian national technology agency ENEA, but he has not invested, according to his office.

At this point no one knows which—if any—of these private-sector ventures will prevail, and achieving fusion won't be easy. Says Glen Wurden, a team leader at the plasma physics group at Los Alamos National Laboratory: "To get funding, small companies have to promise the moon. There's a long history where promises have been made and not kept. When you hear a private company say it will have a technology in five years, you roll your eyes." Critics also say these startups are building on technology that was rejected decades ago by government labs or that still hasn't been proved.

That may be so, but these entrepreneurs argue that improvements in computer technology just might make those older designs doable today. One prominent example of this trend is General Fusion, the company backed by Bezos. (Retired NASA astronaut Mark Kelly is one of the startup's advisers, and in August the government of Malaysia led a new $22 million round of financing.) It is building on the concept of compressing fuel to heat it until it triggers a fusion reaction, an idea experimented with for years in large-scale government programs. At the Livermore lab, for example, lasers the length of football fields are being used to compress atoms into fusion. So far these expensive laser systems require more energy to operate than they produce. In 2002, Michel Laberge, a Canadian plasma physicist, had an idea. What if you replaced those expensive lasers with a hammer and anvil system that created a shock wave that would force the particles into a fusion reaction? Soon after, he founded General Fusion.

Hammers, too, had been tried before in government labs in the 1970s but failed. Now, thanks to advanced algorithms, modern electronics, and control systems, the hammers can hit the side of General Fusion's sphere-shaped metal reactor precisely at the same time, creating a pressure wave that compresses the plasma into a fusion reaction at 100 million degrees centigrade. The heat is transferred into a swirling vortex of molten metal, which then gets captured by a steam generator.

General Fusion CEO Nathan Gilliland, who

$500 million *Investment necessary for U.S. to remain competitive for the Internet of things, semiconductor industry says* / **60%** **Estimated price reduction for lithium-ion batteries by 2020**

ALLEN: FRAZER HARRISON—GETTY IMAGES; TRI ALPHA: COURTESY OF TRI ALPHA ENERGY; THIEL: STEVE JENNINGS—GETTY IMAGES; HELION: COURTESY OF HELION ENERGY; BEZOS: K. ASIF—INDIA TODAY GROUP/GETTY IMAGES; GENERAL FUSION: COURTESY OF GENERAL FUSION

previously worked at Bain Capital, says his company has achieved the right speed and precision of hammers and has created stable, long-lived plasma. Now it's working on fine-tuning the shock waves and compression so that the plasma generates more energy than it consumes. How long will that take before commercialization? Says a confident Gilliland: "We think in terms of years, not decades. We've demonstrated that our pathway is viable. It's just a matter of engineering."

The idea of entrepreneurs working in glorified garages trying to solve one of the most ambitious problems in physics sounds absurd on the surface. After all, governments have spent decades and billions without cracking fusion. Yet these startups have one thing going for them. Because they are working on a smaller scale they have a quicker learning cycle and, theoretically at least, could get to a solution faster and more cheaply.

There's at least one relatively recent example the entrepreneurial set can cite: In the late 1980s the federal government said that mapping the first human genome was going to take 15 years and cost $3 billion. The private sector stepped in and did it much faster and more cheaply. There's certainly no guarantee in this case that private industry will succeed where the government hasn't. But after 50 years it certainly seems worth trying a different approach.

Etosha Cave, co-founder of Opus 12

ELIZABETH D. HERMAN FOR THE NEW YORK TIMES/REDUX

SEEKING THE NEXT ENERGY STAR

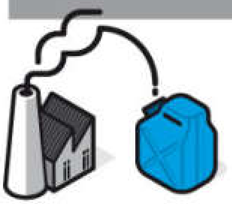
Four innovative, mostly nascent startups will square off for venture capitalist votes at *Fortune*'s Brainstorm E conference. Which has the best idea? ***By Brian Dumaine and Katie Fehrenbacher***

IT'S HARD TODAY even to glance at a business publication without reading about a heavily backed clean-tech startup that is killing it—think Tesla, SolarCity, and SunEdison. But what about those companies that could be right around the corner, ones that have promising ideas but haven't yet launched or found big-money backers? For *Fortune*'s Brainstorm E conference, which explores the intersection of energy, technology, and sustainability, and was scheduled to be held Sept. 28 and 29 in Austin, the magazine's editors, after interviewing consultants and investors, have picked four early startups whose founders will pitch their ideas to a panel of venture capitalists.

Think of it as *Shark Tank* with a sustainability twist. In the short profiles that follow, you'll read about a technology that aims to convert greenhouse gas into fuel, new

772 **Number of Israeli startups acquired between 2003 and 2012** / 3 in 4 *Companies mulling big-data projects, according to a Gartner survey*

cloud-based software that will make rooftop solar installations more affordable, a gadget that lets you track your home energy use, and a battery that would triple the range of a Tesla. Three of the products are so fledgling that they haven't yet hit the market, but all four have promise—as potential hits and as means to a brighter energy future.



OPUS 12

Flipping the script on CO_2

Etosha Cave grew up near an abandoned oil-waste site in Houston, and as a Stanford Ph.D. in mechanical engineering she was inspired to investigate how to turn carbon dioxide—a by-product of burning fossil fuels—into something useful. The result of her research and that of her co-founder, Ph.D. Kendra Kuhl, is a device called an electrochemical reactor. It adds electricity to a mix of carbon dioxide and water and runs that solution over metal catalysts to produce substances such as liquid fuels. From their perch at Lawrence Berkeley National Laboratory in the Bay Area, the scientists are running a five-person startup called Opus 12 inside the accelerator program Cyclotron Road, which is like a hybrid of a Silicon Valley incubator and a government lab. Opus 12 and five other startups receive lab space, access to advisers, and seed funding for two years. A year in, Cave and her team have built a palm-size prototype, and they're working on larger versions of their device. Opus 12 is still at an early phase in a sector that can be capital intensive and slow—but its technology is novel. —*K.F.*

KAIR

A future Tesla killer?

The startup graveyard is filled with battery companies that overpromised. So it's refreshing to find an entrepreneur playing it cool. Damian Beauchamp, a chemistry Ph.D. candidate at Ohio State, is the co-founder of KAir Battery, which plans to make something called a potassium air battery that, if successful, would produce three times the storage of Tesla's batteries at half the price. You won't hear Beauchamp boasting. "We won't know for sure for a year and a half whether we'll reach our goals," he says. Others seem enthusiastic: The Department of Energy granted KAir a $100,000 prize, and the company placed second in the prestigious Rice University business-plan competition. Beauchamp sees opportunity in batteries for homes and businesses that want to store energy generated by their solar panels to use when the sun isn't shining, as well as for utilities that want to store power from wind and solar farms. The DOE has estimated the industry could grow to $17 billion annually by 2020. KAir's potential advantage: Its battery uses potassium, found in many places, including the U.S. By contrast, today's leading technology, lithium ion, depends on a much rarer element found mostly in China, Chile, and Bolivia. Beauchamp's challenge is to get the number of times his batteries can be charged and discharged from 150 to around 1,000. He's "confident he can figure it out"—but he's not making any promises. —*B.D.*

SUNLAYAR

Taking the hassle out of solar

Over the past decade the cost of solar panels has dropped 75%—but solar still can't compete with fossil fuels in many markets without subsidies. Key culprit: costs such as sales, engineering, and installation, which account for 64% of a typical residential solar project, according to the DOE. Claudia Wentworth, co-founder of Sunlayar in Walnut Creek, Calif., thinks her cloud-based software will help. Typically installers struggle with a patchwork of different software programs that don't talk with one another. Sunlayar, which thinks its software is six months from market, offers a cloud-based system that radically consolidates the process of selling and installing solar. The obstacle? Big installers like SolarCity already have their own in-house software systems, notes Pamela Cargill of solar consultancy Chaolysti. That means "putting automation in the hands of" 6,500 mom-and-pop installers "who have very little experience" with software and design. Wentworth replies that all an installer will need is an engineer to check the software results instead of a team of engineers to do the design work. —*B.D.*

CURB

Your home is an energy hog

On a recent sunny afternoon, Erik Norwood's home in Austin is consuming electricity at a rate of a whopping $500 per month. I know this because he has shared his iPad screen with me, and colorful graphs show exactly what appliances are consuming what. He taps the screen a couple of times, turning off his home's air-conditioning and lights, and the predicted utility bill immediately drops. Norwood is showing off gadgets made by Curb, his three-year-old Austin-based startup. The company's devices plug into a circuit breaker, and using sensors, they display energy data in real time. Hardware from partners can extend Curb's use to turning appliances up and down remotely. Norwood says he built the tools because "the way we use energy now is fundamentally broken." Curb's devices run from $250 to $700, which could limit them to early adopters, and predecessors have failed. But that was before ubiquitous connectivity and before Nest's smart thermostat became a hit. —*K.F.*

$75 MILLION *Amount Microsoft will spend to improve children's access to computer-science education*

9 **Major investment banks backing block-chain startup R3**

ILLUSTRATIONS BY **MARTÍN LAKSMAN**

The Greatest Show on Surf

WHY IS SALESFORCE'S ANNUAL CUSTOMER CONFERENCE SO POPULAR? BECAUSE IT DOESN'T FEEL LIKE ONE. *By Michal Lev-Ram*

THE 1,100-ROOM cruise ship docked at Pier 27 in San Francisco features a martini bar, an art gallery, and a rooftop pool. In the lobby a DJ presides over thudding bass as onlookers sip cocktails and mingle. If not for the cyan lanyards around their necks, you might think this was just another party boat setting sail for international waters. (Let the gambling begin!) But this vessel isn't going anywhere—its guests are here to attend a four-day-long corporate technology conference.

The so-called Dreamboat was one of the biggest attractions at this year's Dreamforce, the annual blowout thrown by business-software maker Salesforce and its larger-than-life CEO, Marc Benioff. Dreamforce is the world's largest software industry conference, and it can be hard to grasp how big the bash has become. The first was held 13 years ago at a small hotel in San Francisco's Union Square. Today the only venue that can accommodate its 150,000 attendees—barely—is the Moscone Center, with 700,000 square feet of exhibition space. Salesforce has it booked for the next 25 years.

The key to the event's success? Avoid classic business-conference traps. At every turn, Salesforce works to remind conference-goers that they are there to have fun—not buy software. Outside the convention center are two stages for musical acts, a "meditation tent," and four Airstream trailers where Salesforce employees in Dreamforce-themed pajamas will actually spend the night. Young people wearing blue T-shirts and wide grins stud the show floor. Some can't help dancing.

Salesforce CEO Marc Benioff (left) with Uber CEO Travis Kalanick at Dreamforce 2015

The formal agenda is also a high-wattage affair, with cameos by Adrian Grenier, Goldie Hawn, and John Legend. There are discussions on "ocean innovation" and mindfulness. (A session on women and innovation proved surprisingly controversial.) There is a concert featuring rockers Foo Fighters. And if you look close enough, there's some programming about software too. Benioff's own keynote is a 2½-hour production featuring Cisco CEO Chuck Robbins and Microsoft chairman John Thompson. Lest the audience grow tired of such talk, Benioff waxes poetic on this year's philanthropy challenge—collecting 1 million books for schools across the country.

Salesforce bets that all of this—the eclectic entertainment, immense investment, and effort of hundreds of production workers directed by Metallica stage man Dan Braun—will pay off in software sales. Unsurprisingly, marketing and sales accounts for the company's largest single cost—$2.8 billion in its last fiscal year, more than half its annual revenues and part of the reason it took a $263 million loss in the same time period. It's worth it, says senior vice president Elizabeth Pinkham: "Dreamforce has almost become bigger than Salesforce." F

JAKUB MOSUR

9 MINUTES *AVERAGE AMOUNT OF TIME SOUTH KOREAN STUDENTS USE THE INTERNET AT SCHOOL DURING THE DAY* / **43** Number of U.S. states that will use electronic voting machines at least a decade old in the next election

Not all progressive lenses are created equal.

Get sharp vision and smooth transitions at any distance with *Varilux*.

Varilux is the only progressive lens brand with lenses designed using W.A.V.E. Technology.
Why wear anything else? Get the #1 progressive lens brand. Get *Varilux*.

Learn more at Varilux.com.

VARILUX®
Progressive Lenses

HOW FORD QUANTIFIES ITS FUTURE

AS FORD MOTOR TRIES TO EVOLVE INTO A CAR COMPANY FOR THE 21ST CENTURY, IT'S USING DATA GENERATED BY ITS CONNECTED VEHICLES TO HONE PRODUCT DESIGN, IMPROVE DRIVER EXPERIENCE, AND EVEN DISCOVER NEW BUSINESSES. **BY DERRICK HARRIS**

TELE(MATIC)-COMMUTE

Through a project called Big Data Drive, Ford monitors the routes employees use to drive to work and tracks how long it takes them to do so. Ford hopes this can help it provide better real-time route optimization for navigation systems and fleet vehicles, as well as more accurate predictions of how street closures and other incidents will affect traffic on nearby roads.

A CAR IN EVERY SPOT

Ford is collecting parking-behavior data, among other types, from the sensor-equipped cars of 650 employee volunteers to better inform its ride-sharing pilots in cities around the world.

CLEARING THE AIR (AND STREETS)

Ford is exploring electric bikes and urban route planning. It believes that bicycle sensors can collect more detailed data about pedestrians, traffic, and road conditions than cars can. Combined with other data it collects, the information could help improve traffic flow and therefore reduce climate impacts.

MAKE SAFE DRIVING PAY

Quantified driving behavior could lead to more accurate insurance premiums. Ford believes that connected car data could reduce rates for safe drivers and help rental companies offer them discounts.

PUMP (UP) THE BRAKES

Another Ford pilot program analyzes 25 signals from brake systems—how hard drivers push them, at what speed, and the conditions under which they're applied—to better predict failure.

COURTESY OF FORD MOTOR

96 *MARKETING-TECHNOLOGY COMPANIES THAT RECEIVED VENTURE FUNDING IN Q2 2015*

4.2% **SHARE OF SENIOR U.K. GOVERNMENT STAFF THAT VIEW THEIR CIO AND CTO AS DRIVERS OF CHANGE**


Megyn
Kelly
Anchor, Fox News
Mary
Barra
CEO, GM
Ivanka
Trump
EVP, The Trump Organization
Ursula
Burns
CEO, Xerox
THE
MOST POWERFUL
ANSWERS
TO THE
MOST POWERFUL
QUESTIONS
WATCH OCT 12-14
LIVE
ON FORTUNE.COM
FORTUNE
THE MOST
POWERFUL
WOMEN
SUMMIT
#BeInspired
Kirsten
Gillibrand
US Senator, NY
Mika
Brzezinski
Anchor, MSNBC
Muriel
Bowser
Mayor, Washington D.C.
Katie
Couric
Global Anchor, Yahoo
Copyright 2015 Time Inc. FORTUNE and FORTUNE MPW are trademarks of Time Inc. Speakers subject to change.
Couric photo by Andrew Eccles / AUGUST

Invest

PLAYING DEFENSE

Are You Ready for the Next Bear Market?

Recent market jitters have investors worried that a crash may be coming. The good news: Many of them already have the tools they need to weather any turmoil.

By Joshua M. Brown

ILLUSTRATION BY BEN FEARNLEY

YOU PROMISED yourself you would never go through another 2008 without being prepared. "Never again" you said as the market rebounded off the bear market lows and your portfolio clawed its way back from a 50% drawdown. "I went through this in 2000 and then again in '08. Next time, I'm going to be ready and protected."

Next time might be now.

So have you prepared? Have you kept your promise? Are you about to find out?

The recent resurgence in volatility may have you asking yourself similar questions. It comes after a record-setting period of smooth sailing for U.S. stocks, a correction-free market environment when every dip was reversed before you had the chance to make it back from Starbucks.

Sure, we had gotten close to a 10% correction in the S&P 500 in recent years. The 2013 "taper tantrum" drove the index down about 7% before the Fed spun into damage control from its earlier statements. The October 2014 dip was a closer call, with the large-cap index dropping some 9% as ISIS rampaged its way across Iraq and every sneezing airline passenger portended a domestic Ebola epidemic. As those fears subsided, the index once again recovered and climbed to all-time highs. Crisis averted.

But August's tumble finally took the index past that psychologically important 10% mark. And despite a partial rebound in stocks since then, investors have a nagging feeling that something is still amiss. This uneasiness shows up in all the sentiment surveys; we're not seeing the bullishness that typically follows a market recovery. With each successive bounce for the major averages, there are fewer and fewer stocks participating. The invincibility we felt when the Federal Reserve was drowning the investment markets in billions of dollars' worth of buying power each month is gone. We're not quite jumping into the pool feet first the way we once were.

DESPITE A PARTIAL REBOUND IN STOCKS SINCE AUGUST, INVESTORS HAVE A NAGGING FEELING THAT SOMETHING IS STILL AMISS ... A NEW SENSE OF UNCERTAINTY HAS CREPT IN.

In the absence of this gusto, a new sense of uncertainty has crept in. As J.R.R. Tolkien's elfin sorceress Galadriel intoned, "The world is changed. I feel it in the water. I feel it in the earth. I smell it in the air. Much that once was is lost."

There are lots of reasons for investors to feel that something is off. China's economy and stock market are in their worst shape since the global recovery began. Brazil is in even worse shape, with a looming budget disaster and the ongoing commodity crash pushing its stock market to within 10% of its lows from the great financial crisis. Europe's economic malaise is unresolved, and the Middle East is, well, being the Middle East. And then there is the ongoing fear about the future course and timing of interest rate hikes.

A more recent fear that has been driven to the fore revolves around market structure and the lack of confidence that the system will be able to hold up under duress. U.S. mutual funds and ETFs currently hold $18 trillion of investors' capital, and, to paraphrase Jack Bogle, if everyone wants his money back at once, it's not going to happen. We recently got a little taste of what something like that could look like. On Aug. 24, a combination of retail investor redemptions, exacerbated by algorithmic (read: nonsentient) trading, pushed the Dow Jones industrial average down more than 1,000 points within minutes of the market open.

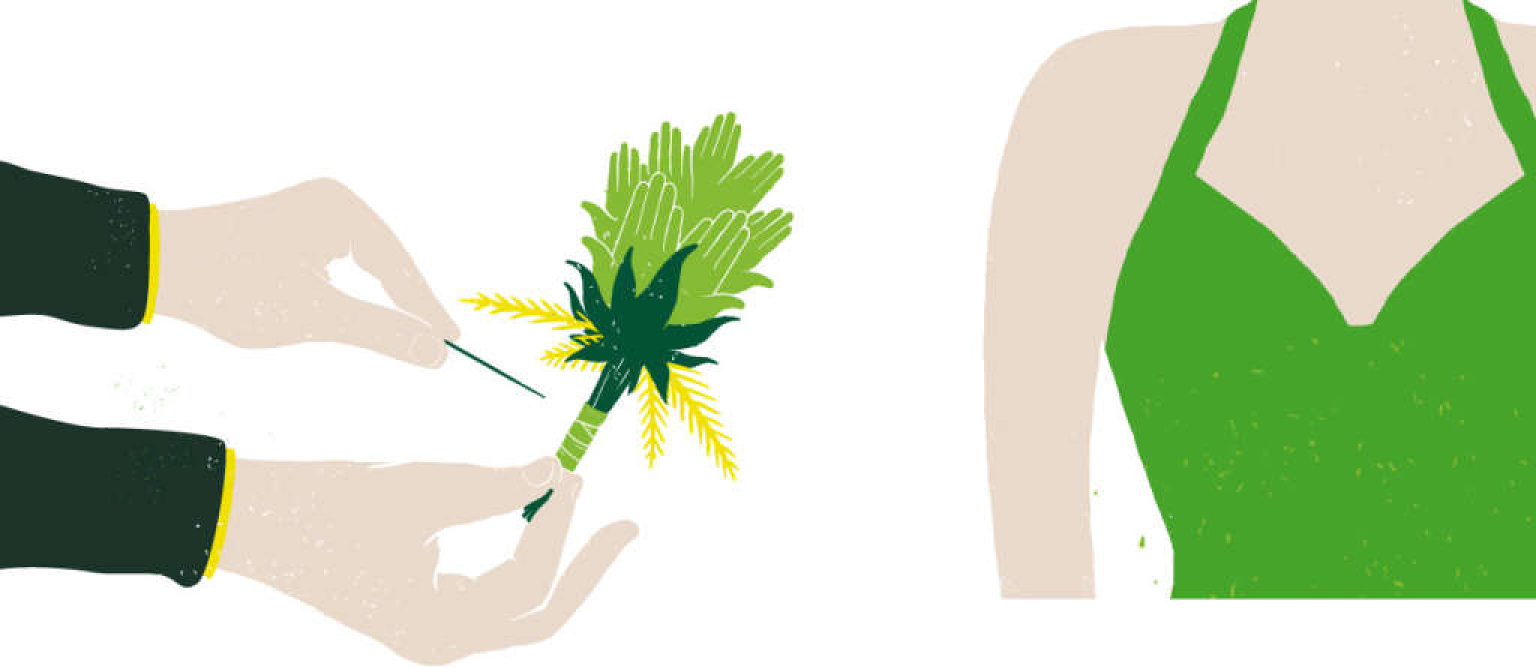
More than 1,200 individual stocks were halted on the NYSE that morning under a circuit-breaker rule that was created to stop declines from becoming full-blown panics. Exchange-traded funds, which typically hew fairly closely to the value of their underlying holdings, became utterly divorced from reality as a result of these circuit breakers, with several popular ETFs "gapping down" to trade at 20% to 40% lower than the value of their underlying assets.

Although these dislocations were rectified in short order that day, they've made an indelible impression on retail investors. The ubiquitous complaints from professionals about the dangers of fading market liquidity are resonating with the general public now that they've seen a flesh-and-blood example.

Approximately 56% of the U.S. mutual fund industry's assets are in the stock market, with another 22% invested in bonds. Investors in these products have not panicked yet; they are holding on but gritting their teeth. For U.S. stock funds, outflows for the month of August totaled a net $5.9 billion. That's a relatively small number when compared with the $9.6 billion investors ripped out in July, or the gigantic outflow of almost $26 billion back in April. In other words, with very little net selling by mutual fund and ETF shareholders, we still managed to see quite a bit of discombobulation in the marketplace.

The lingering question is, What happens when it gets real? Very few of the most vocal market commentators believe that the system can withstand a real risk-off moment when investors bail out of stocks en masse. You're forgiven for watching the day-to-day market proceedings from the edge of your seat. It's completely understandable.

Let's get back to that promise you made to yourself—the one about being prepared for the next bear market or economic conundrum. At my wealth management firm, we approach these types of concerns by addressing them in the context of our



clients' individual financial plans. Here are some of the specific questions we find ourselves dealing with in an environment like this one.

AM I OVEREXPOSED TO THE STOCK MARKET? There is a feature of the investment markets known as the equity risk premium. Equities have been able to deliver an inflation-adjusted annual return above the return of the risk-free rate (the return on short-term Treasury bills) that is somewhere around 5%. This higher rate of return makes a big difference over years and decades as it compounds your wealth, but it comes at a price. You aren't awarded this premium just for waking up in the morning; you have to earn it. You earn it by balancing all the short-term negativity against your awareness of your own long-term-return needs.

These days we're asking more from our portfolios than ever before. Retirements are becoming a multidecade affair for a large portion of the population as we age more gracefully and live longer, more active lives. Unfortunately, these extra years of living (and spending) demand a higher tolerance for the variability and volatility of equity returns. To determine whether you're too exposed to stocks, the first step is identifying what you need to get from your portfolio and for how long. This is equal parts art and science, with a bit of psychology thrown into the mix as well.

There are two very important things about stock investing that most people forget when turmoil shows up. The first is that expected future returns are rising when the market is falling. The second is that preserving the nominal amount of dollars you currently hold will not fund a retirement; only the preservation of purchasing power will. For this reason you're actually taking a bigger risk by not maintaining equity exposure.

WHAT ABOUT INTEREST-RATE RISK? Bond market risk is a puppy dog compared with the uncaged tiger that is the stock market. A bad year for a diversified portfolio of investment-grade bonds looks like a mid-single-digit loss, as opposed to the average annual decline of 14% that the S&P 500 suffers in a down year. Rising interest rates pose a risk for bond investors because when newer bonds are issued with higher coupons, the value of existing bonds with lower coupons declines as investors trade up. Fixed-income securities that are paying out at a lower interest rate than the prevailing interest rate of the day find themselves under pressure.

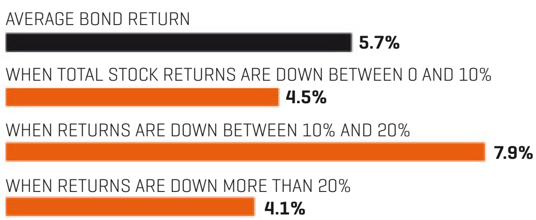
That's why a well-constructed bond portfolio is typically "laddered," with a range of bonds maturing at staggered intervals so that, as lower-yielding bonds mature, newer bonds with higher yields can be purchased, locking in ever higher coupons for the future. This gives a portfolio a built-in defense mechanism against a gradually rising interest rate, which is precisely what the Federal Reserve has in mind right now. The balance of risk, globally speaking, is weighted toward deflation as opposed to inflation, which means the Fed has no need to hurry the pace of interest rate increases anytime soon. In this context, for investors, slowly rising rates represent more

Play It Safe (Just Not *Too* Safe)

Bonds can cushion a portfolio during down years for stocks, but investors shouldn't abandon equities.

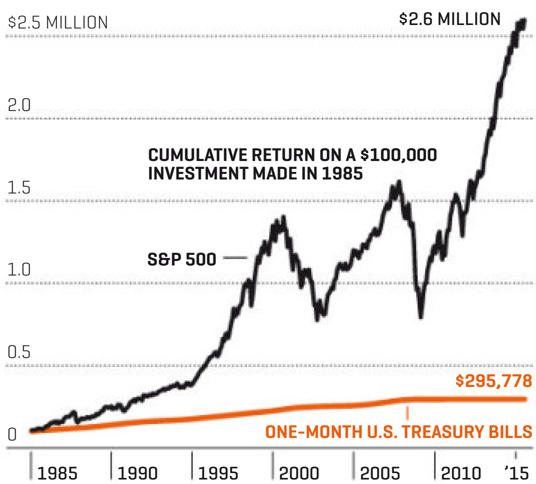
How bonds fare when stocks fall

BOND RETURNS DURING ROLLING THREE-YEAR PERIODS*



*Mix of bonds (one-month T-bills: 7.5%; five-year Treasury notes: 12.5%; long-term corporate bonds: 30%; long-term government bonds: 50%)

Getting Paid for Taking Risks



GRAPHIC SOURCES: RITHOLTZ WEALTH MANAGEMENT; DIMENSIONAL FUND ADVISORS


A STAR ALLIANCE MEMBER
Hard deadlines.
Rough day.
Smooth finish.
Air travel engineered around you
Nonstop you
Make your time with us all yours. Because we engineer your travel experience to be exactly what you need it to be from the last checked email to your first taste of relaxation. Lufthansa wants you to sit back and enjoy your trip even before you arrive at your destination.
Lufthansa
LH.com/us/nonstopyou

4 Survival Tips for Rocky Markets

ONE **STAND BY YOUR STOCKS. Most of us will need portfolios large enough to fund multidecade retirements. That means we can't afford to risk giving up the long-term benefits of equity exposure by bailing out of stocks to avoid short-term losses.**

TWO "LADDER" YOUR BONDS. A laddered portfolio, with a range of bonds maturing at staggered intervals, helps investors capture income from rising interest rates without being hit hard by falling bond prices.

THREE **BEWARE OF HEDGES. Hedge funds, bearish options strategies, and other hedging investments offer to minimize losses and volatility when stocks fall, but their underperformance in rising markets could hurt you in the long run.**

FOUR THINK LONG TERM. Bonds and stocks may fall at the same time in the short term, but over one to three years, diversification begins to pay off.

[redacted]

of a silver lining than they do a serious threat.

SHOULD I BE HEDGING MORE? It's possible that you've gotten serious about hedging against some of the epic volatility that was keeping you up at night between 2008 and 2011. But not all hedges are created equal, and some work only periodically. Some hedges are not hedges at all; rather, they are merely a different set of risks in disguise. Other hedges fail you at the very moment you need them most. Still other forms of hedging can be so incredibly expensive or impractical that they actually end up being a cost for you over the course of a full cycle.

Hedge funds, "black swan" funds, bearish options strategies, managed futures funds, gold and gold mining stocks, unconstrained bond funds, market-timing services, and volatility arbitrage vehicles have all contributed to investor frustration during the post-crisis recovery. While they should not be expected to compare favorably with a bull market, the magnitude of their underperformance sets up a very high hurdle for the next bear market: Many of them have inflicted so much damage on investor portfolios that it would be impossible to earn their keep no matter how severe the next downturn becomes. The most crucial thing to understand about hedges is that their cost to the long-term investor is not always worth bearing. There are some risks in this world that are worse than volatility.

WHAT IF STOCKS AND BONDS SELL OFF AT THE SAME TIME? The nightmare scenario for the investor who has prudently divided up her assets among stocks and bonds is sitting by helplessly as they both sell off at the same time. This situation would temporarily negate the benefits of diversification and rebalancing. And right now, with both bonds and stocks selling at historically high valuations, this is a distinct possibility.

In fact, it's happened before, although only very rarely. In just three of the past 88 years, bonds and stocks have had negative returns at the same time (1931, 1941, and 1969). In those three years, investors lost money in both the S&P 500 and the 10-year Treasury note. In other words, during just 3.4% of all annual periods for which we have reliable data, a diversified portfolio didn't work. To which the rational person would say, "So what." Considering that you are most likely investing for a period of greater than one year, this is a potential risk that is not worth obsessing over.

Investors should not expect their bond portfolios to protect them from every bad month in the stock market. The benefits of diversification among the two asset classes typically take between one to three years to show up. Consider that the monthly return for a portfolio of government and corporate bonds is actually much lower on average during a month when stocks fall. This is highly counterintuitive, but it doesn't really matter when looking at the longer term. The fact is that this same portfolio of bonds has returned an average of 7.9% for all rolling three-year periods during which stocks have fallen by 10% to 20%. These are the times when the diversification benefit truly shines through.

You might be feeling more consternation about your portfolio this fall than you've felt for a while, now that the gains are not coming automatically anymore. This is entirely natural, and it's nothing to be ashamed about. The good news is that, historically, a crisis rarely materializes when nervousness is already so widespread. Investors aren't bidding up valuations to reckless levels or completely disregarding the risks. In this way fear keeps markets at a more reasonable level and acts as a governor of sorts, keeping us all in check.

Should this summer's volatility persist, it would help to remind yourself that every day you endure it, you are earning the premium long-term returns that not all investors have the stomach for. That makes you the winner of a game that many others consistently lose.

Joshua M. Brown is CEO of Ritholtz Wealth Management, a registered investment advisory firm, and writes the Reformed Broker blog.

OPEN FOLDOUT
TO READ MORE!

UNDER FORTY

We may think we live in the age of the tech unicorn, but disruption is coming at us from all corners of industry, as our 2015 ranking of the most influential young people in business shows. There are tech names here, yes, but also stars in health care, autos, finance, food, real estate, comedy, and even ultimate fighting (welcome, Ronda Rousey). The one thing these mavericks have in common: They make their own rules. For the first time our list is 100% brand-new; for select 40 Under 40 alumni named to our hall of fame, see page 38. Read on—and be inspired.

REPORTED BY

DANIEL ROBERTS, RUPALI ARORA, SCOTT CENDROWSKI, JONATHAN CHEW, JASON CIPRIANI, HEATHER CLANCY, ERIKA FRY, STEPHEN GANDEL, BEN GEIER, ERIN GRIFFITH, CLAIRE GRODEN, ROBERT HACKETT, KIA KOKALITCHEVA, BETH KOWITT, ADAM LASHINSKY, MICHAL LEV-RAM, LAURA LORENZETTI, CHRIS MATTHEWS, TORY NEWMYER, ANDREW NUSCA, LUKE O'BRIEN, DAN PRIMACK, LEENA RAO, PATRICIA SELLERS, BENJAMIN SNYDER, AND JEN WIECZNER

ILLUSTRATION BY SINELAB


The 2015 Infiniti Q70L
INFINITI.
INSPIRED PERFORMANCE™

1. ADAM NEUMANN *36*

CO-FOUNDER AND CEO

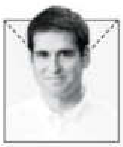
WEWORK

Israeli-born Neumann is bringing startup culture to Big Business: With 54 locations across the U.S., Europe, and Israel, WeWork's perk-filled, keg-friendly communal work-spaces have attracted more than 30,000 members around the globe—and the company is increasingly signing deals with *Fortune* 500 companies like American Express and Microsoft. A $400 million funding round from Fidelity, J.P. Morgan, and other biggies in June raised WeWork's valu-ation to $10 billion, up from $5 billion just last December.

2. JB STRAUBEL *39*

CHIEF TECHNICAL OFFICER

TESLA



The Stanford energy-systems engineer and aeronautics whiz initially met with Tesla CEO Elon Musk to talk about electric planes—both are pilots—but ended up connecting over Musk's dreams of an electric-car company. After helping persuade Musk to fund what would become Tesla, Straubel became CTO, and more than a decade later he's still there, often testing new hardware in his own Tesla models.

FUN FACT JB STRAUBEL'S first car was a Subaru.

3

Ryan Graves *32*

HEAD OF GLOBAL OPERATIONS, UBER

Logan Green *31;* John Zimmer *31*

CO-FOUNDER AND CEO;
CO-FOUNDER AND PRESIDENT; LYFT

Cheng Wei *32;* Jean Liu *37*

CO-FOUNDER; PRESIDENT; DIDI KUAIDI

Ride sharing is taking over the world, and these five are leading the charge. Graves, Uber's first employee, first CEO, and a director (his stake is said to be worth roughly $1 billion) is building teams in new growth areas like China and Southeast Asia. Zimmer and Green founded smaller-but-feisty Lyft, No. 2 in the U.S., which grew revenues fivefold last year and this year scored $100 million in funding from Carl Icahn. The action's now in China, where the No. 1 and No. 2 players—Tencent-backed Didi Dache and Alibaba-backed Kuaidi Dache—combined to form Didi Kuaidi, valued at $15 billion. The merger gave the company—which has a new deal with Lyft—80%-plus market share just as Uber came to town.

Clockwise from top: Ryan Graves; John Zimmer; Jean Liu; Cheng Wei; Logan Green

4. DHIVYA SURYADEVARA *36*

VP FINANCE/TREASURER; GM CEO; GM ASSET MANAGEMENT

The 35-year-old native of Chennai, India, has been the CIO of GM Asset Manage-ment since 2013, where she has managed $80 billion in assets in the automaker's retirement plans. Earlier this year she added VP of finance and treasurer to her résumé, making her the company's youngest corporate officer. The Harvard Business School grad—she moved to the U.S. to enroll—says going to a legacy company rather than a startup means she gets to "look at things from a fresh perspective."

5. JAMES PARK *39*

CO-FOUNDER AND CEO

FITBIT

Park origi-nally planned a career in medicine; instead, he's guiding health tracker Fitbit to the forefront of the hypercom-petitive wearables industry, selling 4.5 million units and pulling in $400 million in its first quarter as a public company. Fitbit's stock has climbed in the wake of its June IPO, and its market cap is more than $7 billion—making Park's healthy stake worth nearly $700 million.

WE ASKED: ARE WE IN A TECH BUBBLE?

6. TAYLOR SWIFT 25

ENTERTAINER

The megastar was the highest-earning musician last year (and has an estimated net worth of $200 million), but it was her bold stance against free music that earned her respect in business circles. First she stood up to Spotify, pulling her entire catalogue; then she wrote a blog post pressuring Apple to rethink its pay model. (It had refused to pay musicians during Apple Music's first three months.) Apple relented, making Swift the poster child for all artists hoping to reclaim their rights—and their revenue—in a digital world.


FOR MORE, SEE PAGE 26

8. JASON ROBINS 34

CO-FOUNDER AND CEO

DRAFTKINGS

Robins and two friends created DraftKings in 2012 to provide an alternative to season-long fantasy football. Three years later the company has raised $375 million in funding and has a $1.5 billion valuation, plus marketing mega-deals with Major League Baseball, Major League Soccer, NASCAR, UFC, and an exclusive partnership with ESPN. This year DraftKings will pay out over $1 billion in total prize money. But is this gambling? Robins says no, and the law in most places deems it a "game of skill." Five states disagree.

10

John Oliver 38

HOST, EXECUTIVE PRODUCER, *LAST WEEK TONIGHT*

In an era marked by the rise of 140 characters, Oliver has bucked the trend by drawing viewers in huge numbers to his deep dives into injustices like tax exemptions for televangelists and the plight of chicken farmers at the hands of big processors. The result: These important but sometimes seemingly boring issues go viral—and have an impact dubbed the "John Oliver effect." A Ninth Circuit Court judge cited Oliver's segment on U.S. territory rights in a class action in Guam. The day after Oliver encouraged viewers to support net neutrality, a flood of new comments led to major glitches for the FCC's website.

7. VAS NARASIMHAN 39

GLOBAL HEAD OF DEVELOPMENT

NOVARTIS PHARMACEUTICALS

The physician and McKinsey alum has plotted his career to have the largest possible impact on public health. At Novartis he runs one of the industry's biggest drug-development programs, overseeing 9,600 employees, 500 ongoing clinical trials, and a multibillion-dollar budget. Among the FDA approvals his shop has won this year: a heart-failure drug Wall Street thinks has blockbuster potential.

9. DANIEL SCHWARTZ 35

CEO, RESTAURANT BRANDS

INTERNATIONAL

Schwartz was a partner at 3G Capital when it took a majority share in Burger King in 2010 and installed him as EVP and deputy CFO. He became CEO in mid-2013; then Burger King bought Tim Hortons to form Restaurant Brands International, and Schwartz was suddenly in charge of the world's third-largest fast-food company. The 3G-style cost cutting he has put in place has sent Burger King's earnings up 11.5%, bucking industry trends.

11. JASON BUECHEL 37

EVP AND CIO

WHOLE FOODS MARKET

Since joining the company in 2013, the former Accenture consultant has forged a partnership with Instacart and implemented Apple Pay, and he's now testing the company's first loyalty program. But Buechel's rise up the Whole Foods food chain—he's the youngest and newest on the executive team, which makes decisions by consensus—is also a nod to the importance of technology in the company's future.

12. ROBBY MOOK 35

CAMPAIGN MANAGER

HILLARY FOR AMERICA

Mook has seen dark days with Clinton before, engineering an unlikely win for her in the 2008 Nevada caucuses while her bid melted down elsewhere. His low-key resolve faces a stiffer challenge now that he's helming her entire effort. Blowback from Clinton's email controversy has once again knocked the frontrunner on her heels, raising questions about her campaign's handling of the issue. It falls to Mook to keep a rattled organization on task.

JAMES PARK: "Much like Schrödinger's cat, I feel that if we don't look too closely, we are simultaneously in a tech bubble and not in a tech bubble."

STACY BROWN-PHILPOT: "I consulted my 4-year-old daughter about this, and she tells me it's not possible to have this many unicorns."

13. NOAH WINTROUB 39

VICE CHAIRMAN

J.P. MORGAN CHASE

As a twentysomething banker with the San Francisco firm Hambrecht & Quist, Wintroub never went anywhere without his self-styled laminated map of the burgeoning Internet industry. He had an almost evangelical need to persuade everyone that this tech thing was going to be big. It was. And now so is Wintroub, the youngest-ever vice chairman of J.P. Morgan Chase, which bought H&Q. Today Wintroub, a close protégé of the late J.P. Morgan banker Jimmy Lee, heads the bank's Internet and Digital Media practice.

15. JESSICA ALBA 34

FOUNDER

THE HONEST COMPANY

As an expectant mom, actress Alba saw a void in the market for less toxic, more sustainable household goods. The Honest Company is fast filling it, last year selling some $170 million worth of products such as diapers and cleaning supplies in outlets like Costco, Target, Whole Foods, and Nordstrom—a nearly threefold increase over 2013. Alba is expanding the company globally as well as into new categories, with Honest Beauty, a new cosmetics and skin-care line. An IPO may be on the horizon too.

17. KAREN FANG 39

MANAGING DIRECTOR

BANK OF AMERICA

Five years ago, Fang was poached from Goldman Sachs—where she cut her teeth persuading a number of large pensions and endowments to hedge in the run-up to the financial crisis—by Bank of America to run a first-of-its-kind on Wall Street cross-asset structured-strategies group. That team is now 60 people. *Risk* magazine named BofA the top structured-product house on Wall Street, and Fang was tapped by BofA's senior management to streamline the bank's deal-approval process.

19. LISA FALZONE 30

CO-FOUNDER AND CEO

REVEL SYSTEMS

Falzone's company has developed a point-of-sale system based on Apple's iOS mobile platform. Under her direction, Revel has already sold 10,000 such systems to retail customers like Smoothie King and Tully's Coffee; earlier this summer Falzone closed a $110 million funding round. She has also signed a partnership with Intuit—and a major enterprise sales deal with Apple. Next up? International expansion and, she says, an IPO in the next two to three years.

14. HUGO BARRA 38

VICE PRESIDENT

XIAOMI GLOBAL

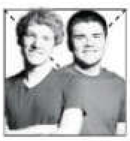
Brazil-born Barra had a plum perch at Google as vice president of Android, but in late 2013 he left for the relatively unknown Chinese startup Xiaomi, now tech's top unicorn, valued at $46 billion. As vice president, Barra has the task of ushering in its inexpensive products to new international markets—growth areas that are more critical than ever as China's smartphone penetration hits all-time highs.

16. PATRICK COLLISON 27

JOHN COLLISON 25

CO-FOUNDERS

STRIPE

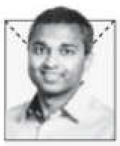


When the brothers Collison founded online payment processor Stripe in 2009, John (left) dropped out of Harvard and they moved to Silicon Valley (cue the Mark Zuckerberg comparisons). Now Stripe, which allows companies to process payments in 100 global currencies with just a few lines of code, has Elon Musk, Peter Thiel, Visa, and American Express as investors and a $5 billion valuation.

18. ANAND SWAMINATHAN 39

MANAGING DIRECTOR

ACCENTURE DIGITAL



Accenture's youngest-ever global-leadership council member runs its fastest-growing business: The $6 billion Accenture Digital is growing 30% year-over-year and winning recognition for digital marketing, analytics, and mobility projects. Swaminathan also engineered six acquisitions in the past 12 months, manages 30,000 people, has advised more than 45 startups, and, in his spare time, heli-skis.

20. PARKER CONRAD 35

CO-FOUNDER AND CEO

ZENEFITS

Zenefits offers cloud-based HR software that helps companies manage health care coverage. And it has reached 1,600 employees and a $4.5 billion valuation in just two years—all after Conrad flunked out of Harvard (then graduated), beat testicular cancer at 24, and got pushed out of his previous startup. No wonder he's unfazed by an ongoing lawsuit with ADP: "It's so clear to me that we're right."

JARED KUSHNER: "No. We are in an industrial revolution, which makes it hard to value the future potential of these globally transformative businesses."

JULIA HARTZ: "This is a special time in Silicon Valley—both good and bad."
ASHIFI GOGO: "Feels so. Is it time for ... disruption?"

13: STEPHEN LOVEKIN—GETTY IMAGES; 14: DAVID PAUL MORRIS—BLOOMBERG VIA GETTY IMAGES; 15: VIVIEN KILLILEA—GETTY IMAGES; 16: 27: GABRIELA HASBUN—COURTESY OF STRIPE; 17: COURTESY OF BANK OF AMERICA; 18: COURTESY OF ACCENTURE; 19: BENJAMIN RASMUSSEN; 20: JIM WILSON—THE NEW YORK TIMES/REDUX; 21, ACKERLY: BILL O'LEARY—THE WASHINGTON POST VIA GETTY IMAGES; HINDAWI: COURTESY OF TANIUM; STAMOS: WIN MCNAMEE—GETTY IMAGES; 22: CHINAFOTOPRESS VIA GETTY IMAGES; 23: BENJAMIN RASMUSSEN; 24: COURTESY OF GOLDMAN SACHS; 25: COURTESY OF KUSHNER COS.

21

Will Ackerly 35
CO-FOUNDER AND CTO, VIRTU

Orion Hindawi 35
CO-FOUNDER AND CTO, TANIUM

Alex Stamos 36
CHIEF SECURITY OFFICER, FACEBOOK

If 2015 was the year of the hack, 2016 may well be the year of the cybersecurity officer. Stamos, who jumped from Yahoo to the top security job at Facebook, had already made headlines when he publicly challenged NSA chief Michael S. Rogers for suggesting tech companies provide access to users' encrypted data. Ackerly was one of the NSA's whiz kids who, like Edward Snowden, grew disturbed by the extent of the agency's spying—and invented a technology that can protect your data from anyone bent on stealing it. Hindawi and his father helm Tanium, the white-hot security startup valued at $3.5 billion, and Andreessen Horowitz's largest investment to date. (The Hindawis' last company, BigFix, sold to IBM for a reported $400 million.)

FOR MORE ON ACKERLY, SEE PAGE 40

Clockwise from top: Will Ackerly; Alex Stamos; Orion Hindawi

22. FRANK WANG 35
FOUNDER AND CEO
DJI

Wang founded Da-Jiang Innovations (DJI) nine years ago. Now it's the world's largest consumer-drone maker, with some 70% of the market. Skyrocketing demand for DJI's Phantom drone—an engineering marvel with a built-in camera targeted to home enthusiasts—earned it a spot in the Apple Store, and the FAA, which in January opened up the U.S. skies to commercial operators, has so far approved 10 times more DJI drones than its competitors'. In May, Wang raised $75 million from Accel Partners at a lofty $8 billion valuation.

23. APOORVA MEHTA 29
FOUNDER AND CEO
INSTACART

Instacart connects users with personal grocery shoppers who handpick and deliver your order in hours. Early investors were skeptical, but Mehta knew the industry was ripe for a change: Today the company operates in 18 cities, partners with Whole Foods and Costco, and has a $2 billion valuation. Now Mehta just needs to fend off Amazon, Walmart, Google, and Uber, all of which want into the market.

24. STEPHANIE COHEN 38
GLOBAL HEAD OF FINANCIAL SPONSOR M&A, GOLDMAN SACHS

In May, Cohen was named Goldman's global head of financial sponsor M&A, a high-profile job arguably created with her in mind: She started as an analyst in 1999, quickly rising the ranks to partner and head of industrials, an area where financial sponsors like private equity firms are a constant presence. Now her new team is bridging Goldman's industry-specific M&A functions with its financial sponsors groups, helping both and increasing efficiencies for clients. "It's kind of a startup within Goldman," she says.

25. JARED KUSHNER 34
CEO
KUSHNER COS.

Jared Kushner, son of Charles Kushner and son-in-law of Donald Trump, has an unparalleled real estate pedigree. He took over as CEO of Kushner Cos. in 2008, and, much like Trump, he used the corporate foundation his father built to lay siege to the grandest prize in American real estate: Manhattan—a move that looks all the wiser as the market has soared. In 2014 his firm completed more than $2 billion in transactions.

DHIVYA SURYADEVARA: "Many people smarter than I am have been humbled trying to predict this."

26. MELANIE WHELAN 38

CEO

SOULCYCLE

The former VP of business development at fitness chain Equinox took over as CEO of SoulCycle, the sizzling hot cult cycling chain, in June. (Equinox owns 97%.) A month later, SoulCycle filed to go public, tasking Whelan with seeing the company through its impending IPO and navigating her ambitious expansion plan. SoulCycle now has 38 locations across the U.S., and the filing revealed something rarer than a unicorn: The business is profitable, bringing in $112 million in sales and $26.5 million in net income last year.

28. MICHELLE DIPP 39

CO-FOUNDER AND CEO

OVASCIENCE

Dipp graduated from the University of Oxford with an MD and a Ph.D., became VP of Sirtris Pharmaceuticals, and engineered the sale of the company to GlaxoSmithKline for $720 million, later heading GSK's specialized R&D unit. In 2011 she co-founded OvaScience to bring to market a breakthrough for in vitro fertilization: the ability to "revitalize" older eggs, improving embryo quality. Data are promising, but the U.S. FDA has yet to approve it, so Dipp's focus is slowing biological clocks overseas—for now.

30. SAM ALTMAN 30

PRESIDENT

Y COMBINATOR

Last year Paul Graham handpicked Altman to take over as head of Y Combinator, the startup incubator whose graduates include Airbnb and Dropbox. In his short time at the helm, the 30-year-old Altman—an alum of YC's first founder class—has increased the number and type of companies accepted into YC (222 graduates this year), held "startup school" seminars outside Silicon Valley, and reached out to women and minority entrepreneurs. "My goal is to double our impact every year," he says.

32. DEBBIE STERLING 32

FOUNDER AND CEO

GOLDIEBLOX

In 2012, Sterling, a Stanford-trained mechanical engineer, set out to create toys that teach engineering skills to young girls. Three years later GoldieBlox's colorful building kits are now sold in 6,000 stores worldwide, including Target and Toys "R" Us; they'll be in Walmart later this year. GoldieBlox-themed books, TV shows, apps, and apparel are in the works, and look for a girl-powered float next month in the Super Bowl of toys, otherwise known as the Macy's Thanksgiving Day Parade.

27. KAYVON BEYKPOUR 27

CO-FOUNDER AND CEO

PERISCOPE

In an era of app fatigue, the breakout success of Periscope, a live-streaming video app launched in March, is rare. Within a week it had 1 million registered users; in four months it had 10 million. It didn't hurt public intrigue that Twitter acquired it for a rumored $100 million before it even launched. Beykpour manages his team of 24 in a separate San Francisco office away from Twitter's headquarters.

29. STACY BROWN-PHILPOT 39

COO

TASKRABBIT

In August this No. 2 to TaskRabbit founder and CEO Leah Busque scored another big gig, becoming a director of HP. Born in Detroit and raised by a single mother, Brown-Philpot previously spent nine years at Google, where she worked for Sheryl Sandberg ("a mentor"), headed online sales and operations for Google India, and founded the Black Googler Network, a key component of Google's diversity efforts.

31. CHRIS WANSTRATH 30

CO-FOUNDER AND CEO

GITHUB

This wonky tech hub is the world's biggest collection of public code and the de facto place where developers collaborate. Wanstrath launched GitHub in 2008 with Tom Preston-Werner and P.J. Hyett as a way to see and tweak one another's projects. Now it has a $2 billion valuation and 11 million active users, even after weathering a sexual harassment claim that led Preston-Werner to step down.

33. BRIAN SHETH 39

CO-FOUNDER AND PRESIDENT

VISTA EQUITY PARTNERS

When Sheth co-founded Vista Equity Partners in 2000, it became one of the very first private equity firms to focus exclusively on software. Not only has the foresight helped make Sheth a billionaire, but it has also given Vista a leg up when competing with larger investment firms that are relatively new to the software game. In fact, the San Francisco–based firm claims to have never lost money on a buyout.

FUN FACTS **JOSH GOLDIN** is a former ice hockey goalie. **HUGO BARRA** has watched *Back to the Future Part II* roughly 50 times. **MICHELLE DIPP** binge-watches *Suits* and follows its star Gabriel Macht on Twitter. **WILL ACKERLY** used to build vacuum-tube clocks for fun. **BRIAN SHETH** is a huge Bob Marley fan.

26: COURTESY OF SOULCYCLE; 27: COURTESY OF PERISCOPE; 28: COURTESY OF OVASCIENCE; 29: COURTESY OF TASKRABBIT; 30: DAVID PAUL MORRIS—BLOOMBERG VIA GETTY IMAGES; 31: COURTESY OF GITHUB; 32: COURTESY OF GOLDIEBLOX; 33: COURTESY OF VISTA EQUITY PARTNERS

CLOCKWISE FROM TOP: DUBIN, KATZ-MAYFIELD, RAIDER

Michael Dubin 37
CO-FOUNDER AND CEO, DOLLAR SHAVE CLUB

Andy Katz-Mayfield 33
Jeff Raider 34
CO-FOUNDERS AND CO-CEOs, HARRY'S

It was only a few years ago that these archrivals set their sights on shaking up the men's grooming market with well-designed products sold online, by subscription, with prices that undercut the giants Schick (Energizer) and Gillette (Procter & Gamble). It's working. Sales in the category are skyrocketing, and now Gillette has created its own online shave club.

37. YEHUDA SHMIDMAN 34
CEO

SEQUENTIAL BRANDS GROUP

Since joining brand-licensing firm Sequential in 2012, Shmidman has been buying up an A-list roster of labels, including the clothing lines of Jessica Simpson and Justin Timberlake; Ellen Tracy; and Martha Stewart Omnimedia, which in June Sequential said it would buy for $353 million, its largest deal yet (Stewart will join the board). Shmidman—who was once spoofed on *Saturday Night Live*'s "Weekend Update" for his business selling iPods preloaded with Jewish content—has grown the company's total sales at retail from $100 million to roughly $3 billion today.

39. RESHMA SAUJANI 39
FOUNDER AND CEO

GIRLS WHO CODE

After losing a bid for Congress in 2010, Saujani founded Girls Who Code to help underserved girls gain the skills to pursue careers in technology and engineering. Backed by giants like Google and Twitter, it has helped place 10,000 high-school-age girls in 34 states in 57 immersion programs where they learn how to code, develop mobile apps, and receive mentoring from women in engineering at companies like Facebook, Goldman Sachs, and AT&T. Saujani raised $500,000 from corporations in 2012; this year that figure will grow to $16 million.

35. TREVOR NELSON 37
JULIAN STEINBERG 36
JOSH GOLDIN 38
CO-FOUNDERS

ALLIANCE CONSUMER GROWTH

In 2011 these three friends formed their private equity firm—focused on early-stage consumer retail brands—and it has quietly racked up win after win. One of their first: Shake Shack; ACG is the fourth-largest shareholder (it owns 6%). Other investments have sold to Hershey, Coca-Cola, and Boulder Brands.

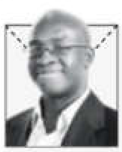
36. JULIA HARTZ 35
CO-FOUNDER AND PRESIDENT

EVENTBRITE

Her husband, Kevin, has the CEO role, but it's Hartz who has become the internal and external face of the online ticketing platform, now said to be worth $1 billion. In addition to running marketing and customer relations, the former MTV exec spends about a third of her time on recruiting. The service is now used to process 4 million tickets a month to events ranging from indie-music shows to Pope Francis's speech in Philadelphia.

38. ASHIFI GOGO 34
CO-FOUNDER AND CEO

SPROXIL



Ghana-born Gogo co-founded Sproxil to fight counterfeit pharmaceuticals in Africa. His authentication technology has since been used to verify the source of more than 19 million products, and it's now finding fakes of all kinds. Bill Clinton called Gogo's company "a remarkable achievement"; in 2013 the Obama administration recognized him as an Immigrant Innovator and a Champion of Change.

40. RONDA ROUSEY 28
FIGHTER

UFC

2015 has been the Year of Ronda. The mixed-martial-arts fighter, undefeated in the ring (many of her bouts last mere seconds), is said to be the most dominant female athlete in her sport ever. Her influence is broadening fast: She's earned nearly $5 million from fighting; she's acted in three big movies; and she's inspiring women everywhere with a recent speech about body image that's been viewed 3.1 million times.

FUN FACTS **ANAND SWAMINATHAN** gets up at 4:30 every morning to spin. **JULIAN STEINBERG** is an avid cook and one of the most active members on Marthastewart.com. **JASON BUECHEL** is a Green Bay Packers shareholder. **MICHAEL DUBIN'S** first concert was Neil Diamond. **TREVOR NELSON** holds a black belt in Muay Thai.

34. DUBIN: MICHAEL LEWIS; KATZ-MAYFIELD & RAIDER: COURTESY OF HARRY'S; 35: DAVE CROSS—COURTESY OF ALLIANCE CONSUMER GROWTH; 36: STEVE JENNINGS—GETTY IMAGES; 37: LIAM MCMULLAN—PATRICK MCMULLAN.COM/AP; 38: COURTESY OF SPROXIL; 39: RANDY BROOKE—WIREIMAGE/GETTY IMAGES; 40: JOSH HEDGES—ZUFFA LLC VIA GETTY IMAGES

2009 – 2015

40 UNDER 40'S GREATEST HITS

The 2015 class of *Fortune*'s 40 Under 40 is a mighty impressive group, but we haven't forgotten some of their legendary peers. There are no repeats on our list this year, which is why there are some household names you don't see (hello, Zuck). Instead, we created our first-ever Hall of Fame: the alumni of the current iteration of the 40 Under 40 (2009–2015) who most embody the spirit of this list.

1

MARK ZUCKERBERG, 31
CO-FOUNDER AND CEO, FACEBOOK

There's a reason the creator of the Social Network—you know the one—has been in the top five of our list every year since we brought it back in 2009. In a dorm room at Harvard he created a social tool that would become globally ubiquitous; now it's an ad powerhouse too. Does anyone know anyone who doesn't know what Facebook is?

2. SERGEY BRIN 42
LARRY PAGE 42
CO-FOUNDERS
GOOGLE

What is there to say about Google that isn't already obvious every time you use a computer? You likely use Google in ways you don't even think about—search, chat, videoconferencing—and it has ambitions well beyond all that, like curing cancer, free Wi-Fi everywhere, and increasing human longevity.

3. ELON MUSK 44
CEO, TESLA
CEO AND CTO, SPACEX

Talk about ambition. Co-founding the first major online-payments platform wasn't enough, so he created a rocket-launching company. Then he made electric vehicles sexy. Now he wants to help people travel through a high-speed tube from L.A. to San Francisco. His life is a science-fiction film.

12 **DANIEL EK** • 32, SPOTIFY • He took on the music industry early on with a streaming service from Sweden; now Apple is getting into the same game.

13 **GARY VAYNERCHUK** • 39, VAYNERMEDIA • He's the self-made, entrepreneurial go-to social media marketing guru—and he's brash and he's bold.

14 **TRACY BRITT COOL** • 31, BERKSHIRE HATHAWAY • Warren Buffett put her in charge of one Berkshire company and on the board of four. "She thinks like I would," he has said.

ILLUSTRATION BY SIMON MORTIMER

4. MARC ANDREESSEN 44
CO-FOUNDER AND GENERAL PARTNER, ANDREESSEN HOROWITZ

The founder of the venture capital firm Andreessen Horowitz is such a revered investor it's easy to forget he's also one of the fathers of the Internet as the co-author of Mosaic and co-founder of Netscape. His ability to see around corners and handpick a success is the stuff of Silicon Valley legend.

5. KEVIN PLANK 43
FOUNDER AND CEO
UNDER ARMOUR

Many small sports-apparel players have tried to take on Nike. Kevin Plank succeeded. His is the ultimate entrepreneur story: He created a wicking undershirt while he was still a college football player to solve his own problem—then grew it into a sports-apparel juggernaut with nearly $4 billion in revenues.

6. MARISSA MAYER 40
CEO
YAHOO

When Mayer first made this list, it was because she was one of the most senior women at Google. Then she took a high-risk leap to go run Yahoo, a company whose future was uncertain. In the process she became one of the most influential female CEOs on the planet.

7. BIZ STONE 41
EVAN WILLIAMS 43
JACK DORSEY 38
CO-FOUNDERS
TWITTER

When they created a mobile-SMS platform for posting a brief status, they had no idea it would become a go-to place for news. Twitter may have its challenges, but it has become central in driving the global conversation, and it isn't going away.

8. MEREDITH WHITNEY 45
FINANCIAL ANALYST

She has since wound down her research firm and shut a nascent hedge fund, but when Whitney made a bold call in 2007 that Citigroup would need to cut its dividend, it shook the entire financial world and cemented her reputation as a Wall Street Nostradamus.

9. TRAVIS KALANICK 39
CO-FOUNDER AND CEO
UBER

His tactics may look brutal to some, but Kalanick single-handedly disrupted the old-school taxi industry and created a new one—app-enabled ride hailing—which has exploded. As Uber has gotten bigger—and more controversial—Kalanick has only amped up his unapologetic approach.

10. BRIAN CHESKY 34
JOE GEBBIA 34
NATE BLECHARCZYK 32
CO-FOUNDERS
AIRBNB

The website these three originally created to cater to couch surfers quickly became a pioneer of the "sharing economy." Then it became a disrupter of the hotel industry. Now it's a platform for 40 million people in 34,000 cities with a $25 billion valuation. Chesky is CEO; Gebbia, chief product officer; Blecharczyk, CTO.

11. ELIZABETH HOLMES 31
FOUNDER AND CEO
THERANOS

Her revolutionary blood analytics company can perform 70 different tests from a single pinprick. Its star-studded board—which includes Henry Kissinger—believes Theranos can get much bigger. Its $9 billion valuation supports that.

15 **DAVID CHANG** • 38, MOMOFUKU RESTAURANT GROUP • An unusual pick—but he's an unusual chef. His cult noodle shop has become a pork-bun empire.

16 **MATTEO RENZI** • 40, PRIME MINISTER, ITALY • The youngest Prime Minister in Italy's history rode a tide of optimism into office and shook up the ruling class.

17 **JONATHAN GRAY** • 45, BLACKSTONE • We put the private equity firm's real estate chief on our list in 2009; he's said to be the heir apparent to CEO Steve Schwarzman.

HOLMES: STEVE JENNINGS—GETTY IMAGES FOR TECHCRUNCH; ZUCKERBERG: FERNANDO VERGARA—AP PHOTO; ANDREESSEN: MICHAEL KOVAC—GETTY IMAGES FOR VANITY FAIR; STONE: PAUL MORIGI—WIREIMAGE/GETTY IMAGES; WHITNEY: KAI NEDDEN—LAIF/REDUX PICTURES; PLANK: JUN SATO—GETTY IMAGES; MAYER: GENE BLEVINS—CORBIS; PAGE: JEFF CHIU—AP PHOTO; BRIN: BROOKS KRAFT—CORBIS; CHANG: ANDY KROPA—INVISION/AP PHOTO

40

UNDER

40

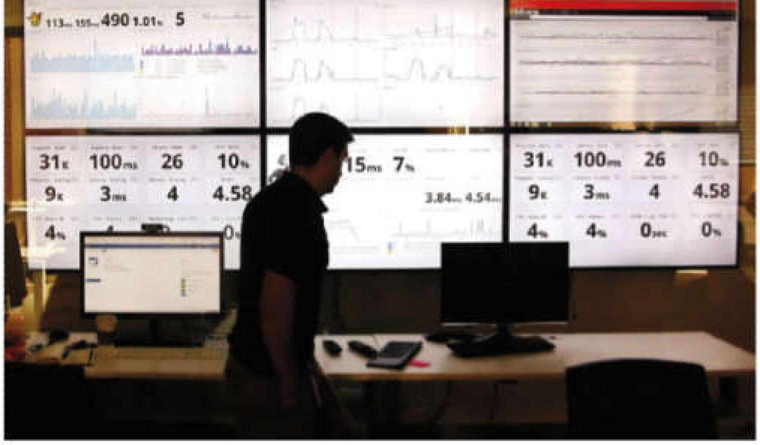
2015

FLIGHT OF FANTASY

No one thought fantasy sports could be a multibillion-dollar business. Not at first, anyway. DraftKings CEO **Jason Robins** is leading the charge in a brutal but bankable market. Are the new business models legal? Depends. But that won't slow him down.

By DANIEL ROBERTS

PHOTOGRAPH BY WESLEY MANN



Above, screens displaying online statistics in the software development department at DraftKings headquarters in Boston; at left, New England Patriots tight end Rob Gronkowski

FROM TOP: STEPHAN SAVOIA—AP; JIM DAVIS—THE BOSTON GLOBE/GETTY IMAGES

There are curses and cheers, flashing bulbs and blinking phones. On the manicured field here at Gillette Stadium outside Boston, before some 67,000 crazed fans, Tom Brady is about to take the first snap of the 2015 NFL season. The atmosphere is electric, and everyone—from the cheerleaders to the beer vendors—seems to be watching the quarterback's outstretched hands.

Except for Jason Robins. The 34-year-old chief executive of DraftKings, the ascendant daily-fantasy-sports startup, is standing in a mammoth luxury suite high above the action. He has a perfect view of the field—but he's glued to his smartphone. He can't resist looking at new registrations for his company's service, the result of a relentless advertising campaign timed to the first week of the new season. "Two hundred thousand sign-ups today," he says with genuine disbelief. That's 10 times what DraftKings has ever seen in a day and just the latest addition to a user base that totals more than 4.5 million people. On the field, Patriots tight end Rob Gronkowski bats away two defenders. "There's too much happening," Robins says without looking up.

You could say the same for the fantasy-sports business. The notion of playing general manager by assembling an imaginary sports team has been around since the 1960s, when a company called Strat-O-Matic created a card game based on the concept. Then, as now, gamers would "play" a season based on the real-life performance of the players on their virtual team. Over time, websites replaced pencil and paper and made results instantaneous. Today mobile applications threaten to replace websites.

DraftKings, founded in 2012 and based in Boston, is one such app. FanDuel, founded in 2009 and based in New York, is another. Both companies have raised hundreds of millions of dollars (and garnered billion-dollar valuations) from blue-chip investors as they vigorously compete for eyeballs and wallets in an estimated $15 billion business. The Fantasy Sports Trade Association, created in 1997 to lobby for the industry, estimates that there are 57 million fantasy-sports participants in North America. This year 8 million of them are expected to try the shorter, more casual "daily" version that DraftKings and FanDuel offer.

How does it work? Select a sport and a contest; draft your players, priced on projected performance (but don't exceed the salary cap); pay the entry fee; pray your lineup fares better than everyone else's. DraftKings saw entry fees rise from $45 million in 2013 to $304 million in 2014—a year in which it reported $30 million in revenue. It remains unprofitable.

All this is legal in most states—for now. The passage of the Unlawful Internet Gambling Enforcement Act of 2006 left room for "games of skill," opening the door to new entrants and revenue streams. Today dozens of companies are engaged in the practice, including CBS, Disney, and Yahoo. But DraftKings and FanDuel control 95% of the daily-fantasy market, estimates Eilers Research, and for now DraftKings appears to have the edge. "DraftKings is outspending FanDuel by 4X," says Eilers partner Adam Krejcik. "So they're seeing the result."

Nowhere is that more apparent than in Robins' luxury suite at Gillette Stadium, the only two-floor suite the venue offers. Inside, former Patriots player Deion Branch reviews his DraftKings lineup on his phone. (He was paid a fee to be here, but he's close with Patriots owner Bob Kraft, who invested in DraftKings.) Twenty DraftKings employees mill about, decked out in company apparel. In the corner is a clutch of gamers who won a DraftKings contest with the ultimate prize: a visit to the real thing.

FEEDBACK: LETTERS@FORTUNE.COM

Before kickoff Robins led a group down from the private suite to the public lower levels to see the brand-new DraftKings Fantasy Sports Zone. It's a large space plastered with the company's branding that is open to anyone with a ticket to the game. In the center is a well-stocked bar; in the corner is an area with tablets where you can sign up for DraftKings. Televisions tuned to ESPN, a new corporate partner, line the walls.

As Robins approached the area for the very first time—he hadn't yet seen it—he looked up at the TV screens. All of them were playing a FanDuel commercial.

He grinned with amusement. "Awesome," he said. "The DraftKings-FanDuel Zone!" Robins snapped a photo with his phone and turned to CFO Tim Dent: "We have got to do something about that." They can't, really—though DraftKings has an exclusive partnership with ESPN, the exclusivity part won't kick in until January.

Meanwhile, the competition between DraftKings and FanDuel will grow only fiercer, especially on TV. On one Monday afternoon this fall, ESPN aired *NFL Primetime* presented by DraftKings. Following that program was *NFL Insiders* presented by FanDuel. When that ended, *NFL Live* presented by DraftKings came on. ESPN has played back-to-back DraftKings and FanDuel ads.

Robins is respectful toward his rival and resists trashing it. "I like the product," he says. "I don't think FanDuel's bad. I just think we're better. The fundamental product that both companies have created is good." (FanDuel CEO Nigel Eccles also admits to testing his competitor's service.)

FanDuel beat DraftKings to market by three years, but its early lead has eroded. Robins tells this story: At an industry event, a FanDuel board member supposedly boasted to a DraftKings board member, "You guys are done. We win; you get 10%. Law of distributions." It hasn't happened that way. "Having an early lead in a nascent market didn't matter," Robins says. Spending $20 million in week one of the NFL season—enough to briefly make it the single-biggest advertiser on television—does. (DraftKings would not comment on its burn rate.)

Back on the field, Gronkowski strolls into the end zone to put the Patriots up 6–0 over the Pittsburgh Steelers. The crowd in the stands erupts with approval. By halftime the Patriots widen the gap to 14–3. Through it all, DraftKings and FanDuel ads incessantly appear on the radio, on television, on billboards, on buses, on websites, and in apps.

Still, both companies face a hurdle much larger than each other: the law. At issue is whether daily-fantasy-sports contests are indeed games of skill and not chance. Put simply, most states say they are. Five states—Arizona, Iowa, Louisiana, Montana, and Washington—disagree. In September, Frank Pallone, a U.S. Democratic congressman from New Jersey, called for a hearing on the legality of fantasy sports. Days later Massachusetts attorney general Maura Healey said her agency was also looking at the legal issues. Pressure comes from both sides: Pallone has advocated legal sports betting in his state; Healey is a vocal opponent of gambling.

If Robins is concerned, he doesn't show it. He's too busy taking it all in. Back in the DraftKings suite he proudly displays his phone, which is buzzing as some of his 300 employees react to the barrage of new sign-ups. "This is nuts," writes one. "I've never seen the lobby light up so much," writes another, referencing the homepage of the DraftKings website and app.

Robins smiles. He's confident that DraftKings has a billion-dollar product. He just needs to get it to the millions of people who haven't yet tried daily fantasy sports—let alone spent money doing it. "Once they try it, they like it," he says. "It's sticky."

First Down, Five States to Go

Q: Are fantasy-sports businesses really legal?

A: For now they are, in 45 states—and thanks to partnerships with major sports leagues and large corporations, there is enough momentum that fantasy sports are probably here to stay. (Federal law also allows them.) But the line often used to explain the legality of the business—it's a game of skill, not chance—is in fact a simplification.

Laws differ in each state for how the skill requirement must be met. In Kansas a contest must prove only that it involves more skill than chance. New York is far tougher: The contest must have no "material amount" of chance. The bar is even higher in Tennessee and Arkansas, where a game of skill must involve no chance whatsoever.

DraftKings currently operates in all these states. Marc Edelman, a law professor at Baruch College, believes that courts there could find that the company is operating illegally.

Still, legalized sports betting could pad state and federal tax coffers, Edelman says. "My expectation is that we will move in the direction of England and have all-out legalized sports betting in the U.S."

It's an interesting scenario for fantasy-sports firms that have operated in the limbo of legal uncertainty. Can they withstand the competition that would result from clear legality? Now that's the billion-dollar question.

our unmanned future

HOW AUTONOMOUS VEHICLES ARE IMPROVING OUR WORLD— AND YOUR LIFE.

we see their rotors spinning

and we don't bat an eye: the sleek executive transport that drops off a CEO at the Wall Street heliport. The military helicopter that lands on the back of a Navy ship or delivers supplies to a disaster-struck region. Traditionally, they are complex machines to fly, and their pilots' workloads can get very high.

However with the advent of fully autonomous and optionally piloted flight capabilities, the landscape is changing—and becoming safer. In the near future, pilotless aircraft could whisk passengers from Manhattan to a meeting 100 miles away or carry people away from the effects of a natural disaster, with more reliability, speed, efficiency, and precision than with human pilots.

"There are so many exciting and innovative new applications of unmanned systems," says Brian Wynne, president and CEO of the Association for Unmanned Vehicle Systems International (AUVSI), based near Washington, D.C. "The technology is developing quickly, and more and more businesses are now able to fly under our evolving FAA regulations."

> **"THE MAIN THRUST FOR OUR PROGRAM IS... TO ALLOW ANYONE TO OPERATE A HELICOPTER WITH AN APP ON AN IPAD."**
>
> — IGOR CHEREPINSKY, HEAD OF AUTONOMOUS ENGINEERING, SIKORSKY AIRCRAFT

Sikorsky Aircraft, for example, a helicopter design and manufacture innovator, is pushing the boundaries of global unmanned systems. Its Matrix Technology is an architecture of apps that enable autonomous execution of complex missions between obstacles with extraordinary reliability.

"Our approach is not necessarily to take people out of flying altogether, but to bring helicopters to the point where anyone can fly them," says Igor Cherepinsky, who leads Sikorsky Aircraft's autonomous engineering program. "Think of the Starship Enterprise," he explains, recalling the fictional Star Trek space ship. "It was operated by five people with a high degree of autonomy. The main thrust for our program is similar—to allow anyone to operate a helicopter with an app on an iPad."

Missions executed by helicopters—search and rescue, humanitarian relief, even emergency medical service—stand to be expanded with unmanned technology helping minimize risk and save lives. For instance, an Insitu ScanEagle drone recently captured infrared video in Washington's Olympic National Park to help steer firefighting aircraft, which were able to deposit fire retardant more precisely, minimizing risk to firefighters and the environment.

"Unpiloted cargo logistics, power line surveillance, crop dusting, border patrol—all of these lend themselves to autonomous capability," says Chris Van Buiten, vice president of Sikorsky Innovations. "And across the board, we are focused on safety, reliability, and cost savings."

Shareholders just may celebrate the innovations: The Teal Group estimates the 10-year market outlook for autonomous vehicles to be in excess of $80 billion.

And as customers gain more trust in autonomous vehicles, the market is just poised to expand.

AUVSI
ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

SIKORSKY

40
UNDER
40
2015

THE ANTI-HACKER

Will Ackerly was a hotshot NSA technologist who grew concerned by the agency's widespread snooping. He left and launched what just may be the best technology to protect your data from cyber-criminals—and government spying.

By LUKE O'BRIEN

PHOTOGRAPHS BY BENJAMIN LOWY

One morning in June 2013, Will Ackerly opened his laptop in his Washington, D.C., apartment and began to worry. The *Guardian* had just published the first of its bombshell articles about the National Security Agency's secret bulk collection of Americans' personal data. Someone was leaking secrets.

Am I going to get a phone call? Ackerly wondered, downing a five-shot espresso.

It wasn't an unreasonable question. Less than a year earlier Ackerly had left his job at NSA headquarters in Fort Meade, Md., where he had worked as a lead security architect for the agency's first cross-domain cloud, a vast database that could connect information on almost anything about anyone. Ackerly had been exposed to a wide range of NSA programs. He'd designed futuristic gadgets and computer systems and been deployed to Iraq to help capture a master bombmaker. All that was in his file. What wasn't: He'd recently driven to the Rhode Island seashore with his girlfriend, who was running a Booz Allen Hamilton encryption team, and asked her to marry him. Two of their friends were there; one happened to work for the *Guardian*.

This coincidence, Ackerly knew, was exactly the kind of data point the NSA tracks from the digital shadows. He'd witnessed the agency's dragnets, which suck in trillions of texts, call logs, and pieces of email metadata, and the court rulings that, in his view, overrode civil liberties. "If you are in their sights on an individualized basis, it's 'game over,'" Ackerly says. Now he had an inkling of what it felt like on the wrong side of the lens.

A few days later, to Ackerly's relief, Edward Snowden came forward as the *Guardian*'s source. What followed was a deluge of classified documents that revealed what a leviathan the NSA had become after 9/11. Like Snowden, Ackerly found the agency's rampant power alarming. Unlike Snowden, he says, he was never going to leak.

Ackerly knew he couldn't prevent mass surveillance—but he could at least try to shield people's information. So he founded a company, Virtru, based on a technology he invented to sheathe individual pieces of data with encryption. He called his creation the Trusted Data Format, or TDF. It makes it dramatically harder for anyone—a private hacker, a foreign state, or one's own government—to pilfer what users want to protect.

Ackerly launched his business with several former NSA colleagues and his brother John, who had worked on tech policy in the George W. Bush administration. (Disclosure: I knew John Ackerly in high school.) To Will Ackerly, the most obvious application for the TDF was email. Nobody had figured out a way to encrypt email that was simple enough for universal use. Ackerly believed he could. He didn't just want to help companies defend against data breaches. He hoped to give everyday Internet users a way to protect themselves online.

The Snowden leaks lent momentum to Ackerly's mission, which has only intensified as disastrous hacks have penetrated institutions ranging from the federal government to Sony Pictures, Anthem, J.P. Morgan Chase, Target, and even Ashley Madison. Data security has become more crucial than ever for individuals, corporations, and governments.

Thousands of companies have embraced Ackerly's technology, including Google, which has partnered with Virtru to serve enterprise customers. Outside observers are also impressed. "I think Virtru will have a great impact on the health care space," says Trung Do, executive director for business development at Partners HealthCare, the parent of several New England hospitals, including Massachusetts General. "They have a pretty ubiquitous platform that's easy to use and is cheap. This thing can scale. That's futuristic to me."

Ackerly himself doesn't quite fit the traditional picture of the business virtuoso who makes *Fortune*'s 40 Under 40 list. He's an idealist as much as an entrepreneur, one who believes that the best way to transmit his ideas is through a company. His brother, CEO of Virtru, is the real businessman in the family. The fledgling company is miles away from an IPO; for now Will Ackerly is paying himself about $30,000 a year and

PREVIOUS SPREAD: BENJAMIN LOWY—REPORTAGE BY GETTY IMAGES

supplementing that salary with poker winnings. What's most important to Ackerly is his earnest dream: that millions of people will use his technology to protect their privacy.

Should Ackerly's TDF attain widespread use, it will mean a technology invented by an NSA staffer with the original goal of helping the intelligence community protect its own information may end up as a tool to block the government's mass data grabs. It's among the many paradoxes of the cyber arms race. Here's another one: Businesses pay billions each year for network security. Essentially, they put a firewall around a data cache and pray. But Ackerly and others argue that it's far more effective to safeguard each piece of information, as the TDF does. This "data-centric" approach is becoming a new cybersecurity paradigm, and Virtru is in a perfect position to capitalize on it.

WILL ACKERLY, who turns 35 on Oct. 2, has the frame of a heavyweight rower and a large head that bobs when he gets excited, which is often. When we met at the Hans Pedr' Kaffe in Washington this past January, he held forth on multiple technical matters, peppering the discussions with dry wit. He described a theory for putting vehicles into orbit without rockets by shooting lasers at photovoltaic panels, then segued into a deadpan *Austin Powers* riff about attaching lasers to sharks. Among the things that excite him are the *Simpsons,* problems to be addressed and solved, and cooking new dishes with his wife. Ackerly's enthusiasm is such that, at one point, occupants of a nearby table glanced over.

The mysteries of code and cognition hold a special appeal. At high levels, mathematical theory and computer science can bleed into what feels like philosophy, and Ackerly can ramble on in this vein. A single question can produce a four-hour answer ranging across satellite artwork, quant trading, and how snobby the CIA can be. He has always had a roving, intense curiosity.

A question about voice-recognition technology elicited cryptic allusions from Ackerly about "some institutions that would be particularly motivated to be the best in the world when it comes to hearing multiple voices and understanding what they're saying." Then he was off on a tangent about the neocortex of a deaf and blind ferret. Before I knew it, he was talking about using the neocortex—of a human—to find patterns and pull signals out of noise from audio and stock market data. A lot of it had to do with the "expectation flow" of inputs such as images that could be propagated through the brain and create a "difference engine" to detect anomalies. "That whole area fascinates me," he says. "I'd love to get into it." Ackerly is precisely what you would imagine an NSA whiz kid to be.

THE LETTER FROM the NSA arrived in the fall of 2003. It contained instructions out of a bad spy movie: *Call this number. Arrive at this hotel. Speak this code word to the receptionist.* A few days before, Ackerly had been sitting in class at the Rose Hulman Institute of Technology in Terre Haute, Ind., finishing up a dual degree in electrical and computer engineering. He had sent in his résumé over the summer. Now he had landed an interview. He had no idea what the job was. But he followed instructions and booked a flight to the Baltimore-Washington airport. When he got there, a van took him to a nearby hotel, where Ackerly approached the receptionist with his code word, an acronym for a made-up organization.

"Hi," he said, trying to act nonchalant. "I'm with OHA." The receptionist flashed him a knowing smile. "Someone will be coming shortly."

Within minutes a taciturn middle-aged man in khakis and a windbreaker materialized. He checked Ackerly's identification and ushered him into a different van, with NORTHROP GRUMMAN on the side. The man barely spoke as they headed for Fort Meade, the nerve center of the "No Such Agency," where cellphone signals drop off the grid and other taciturn men materialize on the shoulders of roads to change flat tires for motorists to keep them moving. (The NSA declined any comment for this article.)

As the van neared the fort, it maneuvered slowly through zigzag barricades and checkpoints manned by the NSA's heavily armed, black-clad paramilitary police. Several of them sat behind sandbag emplacements with SAW machine guns. Looming above it all were the OPS2A and OPS2B buildings, ominous black monoliths girded underneath in copper Faraday cages to block electromagnetic waves. Reflective, bulletproof windows made from tinted double panes of copper-laced glass prevent signals from leaking out. Classical music plays between the panes to further stymie eavesdroppers. Ackerly couldn't wait to get inside.

The NSA is said to employ more mathematicians than any organization in the country. Some 1,000 work there, according to recent media reports, along with some 4,000 computer programmers. Ackerly had

THE OPS2A AND OPS2B BUILDINGS AT NSA'S HEADQUARTERS IN FORT MEADE, MD. THEIR EXTERIOR GLASS IS LACED WITH COPPER TO PREVENT SIGNALS FROM LEAKING; CLASSICAL MUSIC PLAYS TO DETER EAVESDROPPING.

NSA VIA GETTY IMAGES

the ideal background to join them. Growing up in a well-heeled family in Washington, D.C., he'd shown a mischievous, quirky intelligence from early on. He built train sets with his dad, who taught him basic electronics, and played with Capsela, a construction toy with gears and motors. But he generally had more fun taking toys apart to see how they worked. When he was 5 his parents gave him a chemistry set, which led to several fires in the house.

Around the same time the family bought its first computer, an Apple IIGS. "Watching a computer be set up and get turned on for the first time was just an amazing sequence of events," Ackerly says. "I was hooked." He wrote his first program, a simple car-racing game, when he was 7. By 10 he'd learned BASIC from an older computer whiz at school. The two would connect by modem to play games and code. To conceal his excessive modem use, Ackerly rewired a switch in the basement to disable a light on his parents' phone system. In eighth grade he was nabbed hacking into his school's computer system. "I got bored," he says. That was typical in high school, too, where he rarely felt challenged in math and science and neglected his homework. His grades suffered, even as he excelled on elite national tests, such as the American Invitational Mathematics Exam. Learning from textbooks didn't interest him the way puttering around with electronics and code did. At heart he was a tinkerer.

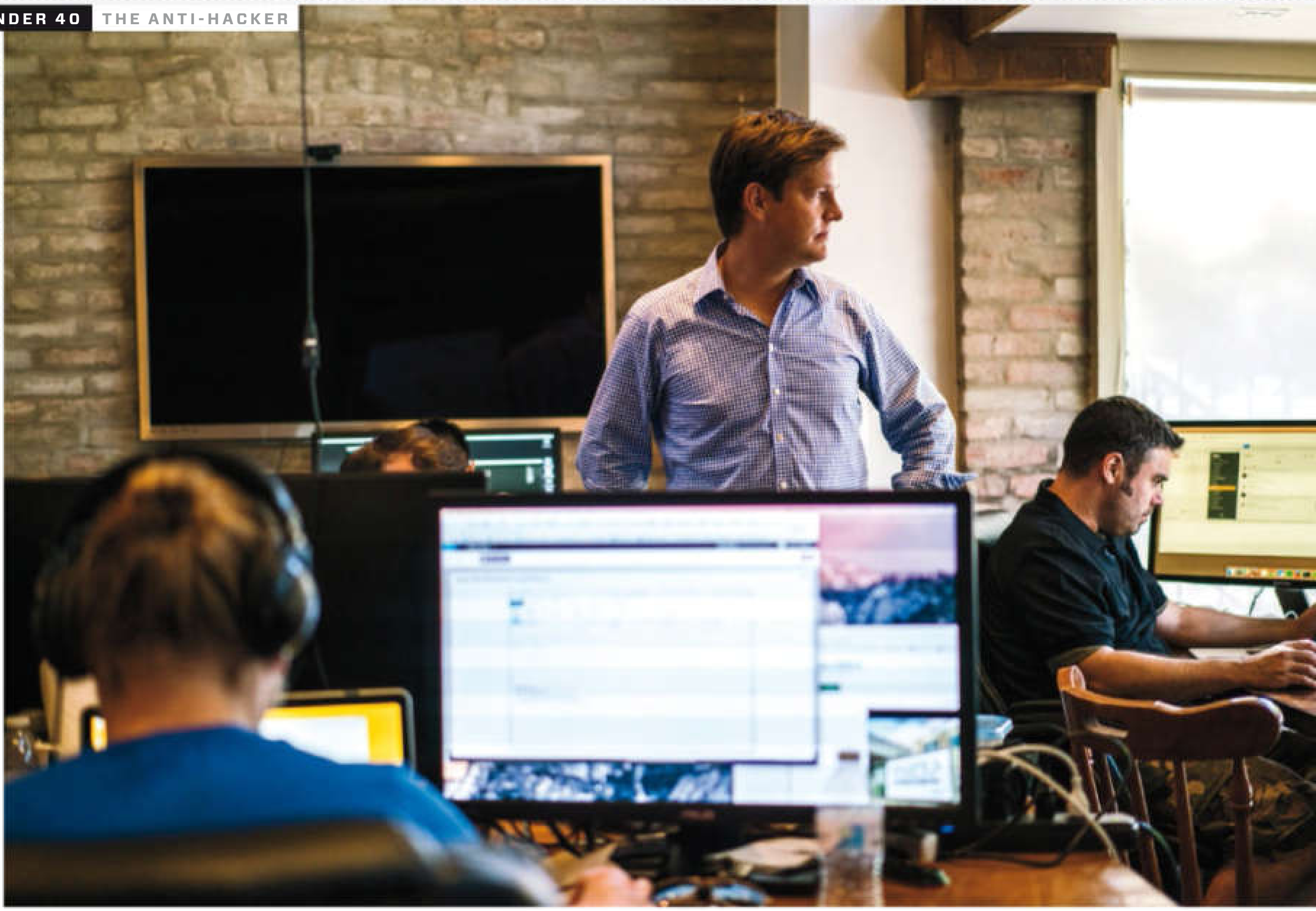
Now he was walking into an organization that tinkered on an unprecedented scale. An NSA scientist showed him racks of equipment to test high-speed photonic communications and walked him past computers that created virtual networks. Within those networks a user could use simulated computers to form other networks, creating a nesting doll of secure workspaces. "What we're tying to do is make the very best encryption work faster," the scientist told him.

Ackerly left the interview in a daze. A few months later another letter arrived. Pending a background check, the NSA had a position for him. The salary was $47,000. He'd start work the coming summer. He still didn't know what the job was. But he knew he couldn't pass it up.

In August 2004 he joined the information assurance arm of the NSA's research directorate. Protecting data—Ackerly's initial role—gets less glory, but it's just as important as hacking. His colleagues were odd and brilliant. (An old joke at the agency captures the stereotype: "How can you tell an extrovert from an introvert at the NSA?" Punch line: "The extrovert stares at *your* shoes."). Ackerly could relate. He could concentrate intensely—he would win big playing round-the-clock poker—but his brain would also "jump" and free-associate to make unusual connections.

Ackerly's job was to create hardware and software to protect information. He experimented with swapping a computer's normal identity chip for ones that allowed the machine to safeguard top-secret info.


More colour. More wonder.
Sport. I love it. Every match, every last minute screamer, every stumble for the finishing line. So I don't just want to watch it, I want to feel it. I want colours so brilliant that I'll feel like I'm in the stadium. Introducing the next generation SUHD TV from Samsung.
See More. Feel More.
SAMSUNG
SUHD TV
With New Nano Crystal Display



JOHN ACKERLY, A FORMER PRIVATE EQUITY EXECUTIVE, PICTURED AT VIRTRU'S OFFICES. HE RUNS THE BUSINESS WHILE HIS BROTHER FOCUSES ON TECHNOLOGY.

He built a tamper-resistant USB log-in fob that would self-destruct if an adversary tried to get in. "It felt like we were building the future," he says.

Of all his projects, secure virtual networks excited him the most. Such networks let groups of users connect to a protected enclave of data to collaborate. They met a pressing need within the intelligence community: Stovepipe databases couldn't communicate with one another, and the future was about sharing. The government was shifting from a "need to know" mind-set, which segregated data by agency and mission—a stance seen as one culprit in the failure to prevent the 9/11 attacks—to a "need to share" approach that emphasized data fusion. The idea was to connect as many dots as possible and prevent another attack.

But secure virtual networks have a weakness. Users can't connect dots across networks with different levels of classification and access policies. On a joint task force, FBI agents might not be able to access the same material as CIA analysts or NSA linguists. For every group working together, you needed to create a new network and import the data.

Ackerly saw a possibility: Eventually networks would become so specialized that they would shrink until they surrounded only one dot—a single piece of data—like a shell. When that happened, you were no longer securing the location of the data. You were protecting the data itself, which allowed it to safely move anywhere. The barriers to collaboration disappeared. Here was the first insight that would lead him to his data wrapper.

ACKERLY WORKED AT THE NSA during a period in which the agency's reach vastly expanded. In the aftermath of 9/11, it was a time of war and the NSA had been unleashed not only abroad but also at home, with Congress and the courts blessing a broad expansion of domestic surveillance.

The extent of the agency's practices only dawned on Ackerly in March 2008, when he attended a presentation by an NSA lawyer at Fort Meade. In four years at the agency, he had never heard anyone lay out the case for the NSA's sweeping powers in that way. As Ackerly understood the explanation, war powers could supercede laws that constrained surveillance. At one point, the lawyer asked for questions. Ackerly stuck up his hand. "Can you think of an example where a domestic surveillance activity would not be granted by war powers?" he

recalls asking. The lawyer said he couldn't.

"That's the first time it hit me," Ackerly says now, "where I got a visceral sense that, whoa, something might be really out of whack."

Ackerly's colleagues took privacy seriously, but the attitude at the top disturbed him. By this point he had joined the Systems and Network Interdisciplinary Program (SNIP), a select three-year course in network, hardware, and software protection and the dark arts of hacking and exploitation. Even as Ackerly trained in offensive operations, he kept pondering how to protect data. He believed strong privacy protections needed to be embedded in technology built for the intelligence community.

In February 2009 he had a breakthrough. Ackerly was driving home through a snowstorm when his brain revved up so abruptly that he had to pull into a supermarket parking lot to make sense of his thoughts. Wrapping data with powerful encryption was easy, he knew. The technology existed to do it. Data could also be tagged with controls to restrict who saw it and where it wound up. These tags were part of the metadata around the data, much like the to and from addresses on an envelope around a letter. What Ackerly had dreamed up was a way to lock the envelope (metadata) to the encrypted letter (data) and let the user digitally notarize it. Encrypted data could be moved around safely. Notarized data could be trusted.

Back in the office a few days later, Ackerly sketched out his idea for the Trusted Data Format for a gifted coder colleague. He wanted help building it. His friend didn't hesitate. He thought it was the kind of technology that could drive radical change.

First, though, Ackerly had to go to war.

THE CHINOOK HELICOPTER swooped low over the plains outside Baghdad, its rotors churning the night air. Through the open ramp at the back, Ackerly watched the landscape rush past in the moonlight. A tail gunner, strapped in with a cable, leaned out the ramp as the helicopter banked toward its rendezvous point. Ackerly had geared up with body armor, an M4 carbine, and night vision. He was going after a terrorist and master bombmaker believed to be aiding the Iraqi insurgency.

As part of SNIP, Ackerly had volunteered to deploy to Iraq with the NSA's elite hacker team. The military sorely needed technicians; one in his special operations unit had recently been killed in action. Ackerly learned to shoot, jam signals, and use tracking beacons. When he arrived in Iraq in October 2009 at a base that came under daily mortar fire, his commander set him up with a desk, a soldering iron, and whatever spare parts that could be wrangled. Ackerly reverse-engineered IEDs, hacked vehicle smart keys, and hid antennas inside fake objects he built with rubber molds. "He was the go-to guy for anything that ran on batteries or plugged into a wall," says Matt Bach, a Navy technician who worked with Ackerly.

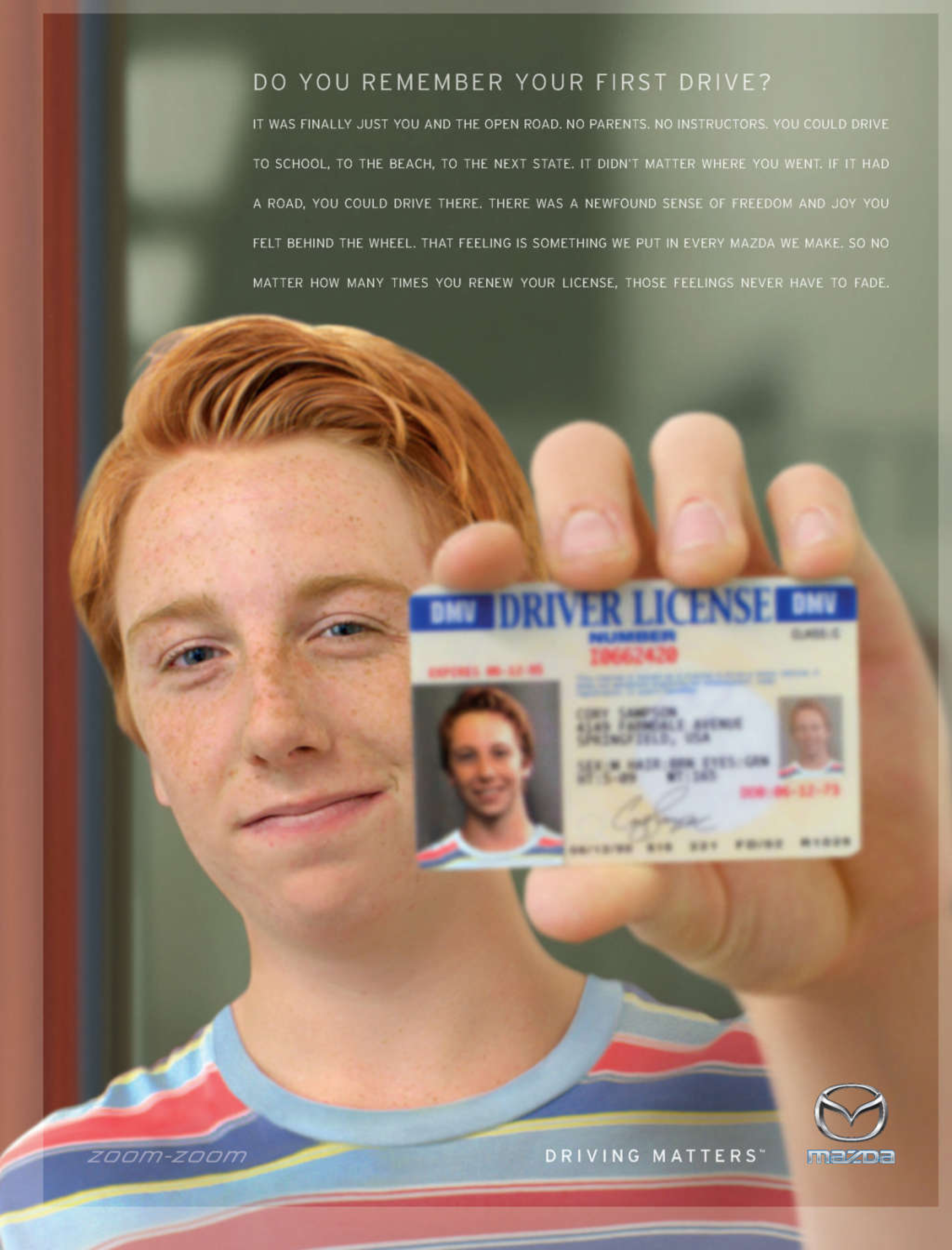
The special ops guys dubbed Ackerly "Q" because of his talent for gadgetry and the strange half-finished devices they found strewn across

IN IRAQ, ACKERLY LEARNED TO SHOOT AND JAM SIGNALS. THE **SPECIAL OPS GUYS DUBBED HIM "Q"** BECAUSE OF HIS TALENT FOR GADGETRY.

his desk. Bach took to calling him "Will-bot" because he considered his friend half-man, half-robot. The two spent a lot of time together in the workshop and the gym. Lifting weights was a new hobby for Ackerly; there wasn't much else to do in Iraq. "Eating, sleeping, and going to the gym," Ackerly says. "And then playing mad scientist."

Somewhere near Baghdad the Chinook touched down in hostile terrain. Time to play mad scientist. The helicopter was on the ground just long enough to get a white sedan up its ramp and into its belly. The car belonged to the targeted terrorist. The unit didn't want to take him down yet. They wanted to monitor him first. Ackerly needed to find a way to track the sedan. He had only a few hours before the target would notice his car was missing.

Ackerly went to work. He can't reveal the specifics of his methods because they're classified, but he rigged the car to be easily monitored. In a similar situation later, he used what he had learned to devise an ingenious unclassified technique. In Iraq white sedans are ubiquitous. Thermal cameras on American drones and planes often lost them behind buildings or in traffic. But what if the vehicle had a unique thermal signature? In a desert country, a car's most useless feature is its rear defroster. Nobody would notice if it wasn't working properly. Using a knife and a screwdriver, Ackerly came up with a simple way to rewire a defroster to surreptitiously activate when the car's engine was running and throw a single bold line of heat across the rear window.


DO YOU REMEMBER YOUR FIRST DRIVE?
IT WAS FINALLY JUST YOU AND THE OPEN ROAD. NO PARENTS. NO INSTRUCTORS. YOU COULD DRIVE TO SCHOOL, TO THE BEACH, TO THE NEXT STATE. IT DIDN'T MATTER WHERE YOU WENT. IF IT HAD A ROAD, YOU COULD DRIVE THERE. THERE WAS A NEWFOUND SENSE OF FREEDOM AND JOY YOU FELT BEHIND THE WHEEL. THAT FEELING IS SOMETHING WE PUT IN EVERY MAZDA WE MAKE. SO NO MATTER HOW MANY TIMES YOU RENEW YOUR LICENSE, THOSE FEELINGS NEVER HAVE TO FADE.
DMV
DRIVER LICENSE
DMV
zoom-zoom
DRIVING MATTERS™
mazda

EVEN IN IRAQ, ACKERLY KEPT THINKING ABOUT **PROTECTING DATA.**

For the next 72 hours American forces followed the sedan before snatching the terrorist one night. The mission was a resounding success, and afterward an Army general told Ackerly he could have any job he wanted. Few NSA operatives return to a cubicle after getting a taste of action, but Ackerly couldn't stop thinking about his TDF. He'd seen the military struggle to encrypt communications in the field, where commanders often used open lines because crypto was too complicated or took too long. It was the same for civilians. Solving this problem was more exciting to him than catching bad guys.

WHEN ACKERLY RETURNED to the NSA in March 2010 he became a lead security architect for Accumulo, a cloud-based database whose size was restricted only by the amount of money and bandwidth available to run it. Accumulo could handle the full spectrum of inputs: audio, video, photos, text. You could drop anything into the system—license-plate-tracking data or DNA records—and it would scrape information and allow users to visualize connections across categories. "The number of actual pieces of data—it's incredible," Ackerly says.

His reservations about mass surveillance had deepened. One night he was talking to two mathematicians on the Accumulo team when the subject of classified court rulings came up. These rulings can grant legal powers that let the government clandestinely collect data about people, including Americans. Section 215 of the Patriot Act, for example, allowed the government to acquire "any tangible things" related to a terrorism investigation. The Foreign Intelligence Surveillance Court determined that to mean the phone records of virtually every person in the U.S.

This interpretation was classified. Ackerly was appalled. How could Americans decide what they were okay with if they couldn't even know it was happening? "It was no longer an issue of 'Can we have this [information] or not?' " he says. "The wolf is in the henhouse, and you've got to make sure that the wolf is extraordinarily contained. You can't just put a fence around the henhouse."

Ackerly knew his TDF could help. Wrapping each piece of data with encryption would ensure that information could be used only as intended. Ackerly finished a prototype in June 2009 and managed to include it in a small pilot program throughout the intelligence community. The Office of the Director of National Intelligence later adopted it as an official specification and published it as an open standard, which meant anybody could use the technology.

Inside the NSA, though, Ackerly's technology languished. It was implemented on a limited basis, but his attempts to get it deployed by the organization bogged down in bureaucratic inertia. Ackerly was frustrated. He felt the future he was building might die on a shelf.

He had recruited several colleagues eager to tackle email encryption and settled on a business name that reflected his feelings about privacy: Virtru. It was time to try his luck on the outside. In August 2012, Ackerly dropped his identity badge in a hopper and drove away from Fort Meade and the hidden, fantastic realm that had been his home for eight years.

THE FEDERAL GOVERNMENT has historically fought the democratization of encryption. In the 1970s, for example, the NSA forced the U.S. Patent Office to classify certain inventions for national security reasons. But cryptographers wouldn't be deterred, especially as personal computers became commonplace.

Early attempts at email encryption fizzled because they required both sender and recipient to use a special program, and not enough people did. In the 1990s a computer scientist named Phil Zimmerman created PGP, which could run on different platforms and was circulated throughout the world over the rapidly expanding Internet. The U.S. government responded by investigating Zimmerman for "exporting a munition" but couldn't contain his invention, which allows for end-to-end encryption where only the parties communicating can decipher messages. They do this by exchanging cryptographic keys, which are long, virtually unhackable strings of numbers. It was email encryption for the people—provided the people were techies. PGP would never go mainstream because it was too difficult to use.

Since then, a smattering of services has tried to simplify privacy technology with varying success. Cryptocat is a browser extension for online chatting that Snowden and journalist Glenn Greenwald used. Silent Circle, launched in 2012 by Zimmerman and a former Navy SEAL, provides robust security for phone calls, texts, and videochat, and has found a home among politicians, celebrities, and other VIPs willing to pay to change devices or software. Wickr is an instant-mes-

ACKERLY AT THE LINCOLN MEMORIAL. "THE WOLF IS IN THE HENHOUSE," HE SAYS OF GOVERNMENT SURVEILLANCE, "AND YOU'VE GOT TO MAKE SURE THE WOLF IS EXTRAORDINARILY CONTAINED."

senger app for smartphones that claims to "forensically destroy" keys after each message is sent, a practice known as perfect forward secrecy.

Encrypted email is more complicated. Mailvelope, a Chrome and Firefox PGP extension, requires users to manage keys. Without a trusted go-between, however, swapping keys is burdensome. And only a small group of people are willing to forgo the comfort of a Yahoo or Gmail account for crypto-email platforms such as Hushmail and StartMail. It can also be dangerous for one company to handle both messages and crypto keys inside a closed system. Lavabit, a secure email service also used by Snowden, shut down rather than comply with a government demand to turn over a master key that would have exposed emails on its server.

For all these reasons, nobody has nailed email encryption. Ackerly thought he could. He had products for companies in mind, but the broader goal—privacy for anyone with an in-box—was equally important to him and his squad of intelligence-community veterans. They set up shop in a house in Arlington, Va., where pizza boxes, Red Bull cans, and an occasional dead mouse piled up as they reverse-engineered Gmail, Yahoo, Outlook, and Mac Mail to create a TDF plug-in. The technology had to be easy to use. A mouse click, no more.

By the spring of 2013 the plug-in was almost ready. Emails were encrypted with perfect forward secrecy, and messages could be set to expire after a period of time or revoked. The sender could control where they were forwarded. Best of all, the plug-in didn't require anyone to change email providers or open multiple accounts. Recipients of the emails could read an encrypted message without needing to download the plug-in.

The team raised $4 million in angel funding, recruited high-profile advisers like Tim Edgar, who served under Barack Obama as the first director of privacy and civil liberties for the White House national security staff, and moved to nicer digs near Dupont Circle. Ackerly purchased a doormat for the office that said COME BACK WITH A WARRANT.

He didn't mind the intelligence community doing its job. His gripe was with dragnet surveillance. He wanted search warrants to be individualized. In his own case, there was little Ackerly and Virtru could turn over. Since the TDF runs on top of existing email providers, Virtru's servers never see emails, and email providers never see Virtru's AES 256-bit encryption keys. (Several experts confirmed Ackerly's security architecture.) It was end-to-end encryption made easy.

"It's going to make bulk collection programs impossible to conduct," says Edgar, who is now a visiting fellow at Brown and focuses on cyberconflict, privacy, and Internet freedom. "Email is still hugely important to society and business and individuals, but it has resisted all sorts of efforts to make it more secure. What Will Ackerly is trying to do is make it extremely easy for an ordinary user to send an encrypted email and also be able to manage that email. If he's successful and his technology is adopted in a widespread way, it really will revolutionize privacy and security for a huge swath of Internet communication."

Ackerly decided to give away Virtru's basic product for free in the hopes of convincing people to act on their self-described desire for privacy. Users, however, would need to have a pint of trust. The only way to make encryption easy for everyone was for Virtru to act as an intermedi-

Less wait. More work.

Reduce downtime by 50%, get 4X faster performance and gain 3X battery life.*

XPS 13

Your employees want to do their best work. Refresh your business and increase productivity with powerfully performing Dell technology and Intel® Core™ processors.

Make work beautiful again at
Dell.com/business or 1-877-414-Dell

Intel Inside®.
Powerful Solution
Outside.

*Comparing systems four years old or more to new systems. Intel, the Intel Logo, Intel Inside, Intel Core, and Core Inside are trademarks of Intel Corporation in the U.S. and/or other countries. Dell, the Dell logo and the Dell badge are trademarks of Dell Inc.

ary for keys. For that reason, transparency was paramount. The TDF is open source. Outside cryptologists can vet it and make it stronger. Ackerly hired iSEC, a security firm, to essentially try to hack the plug-in. He also had his friend Weston Hopkins, who'd been on a winning team at DEF CON, the world's premier hacker competition, hammer on the code. "It's good," Hopkins told me.

Then the Snowden leaks happened, and millions of citizens became alarmed at the vast reach of the NSA. They could see now what Ackerly had seen. Still, he hated watching the agency's lifeblood splashed across the media. He felt Snowden could have prompted the same conversation by releasing only a few documents: "He did an incredible amount of damage," Ackerly says. "He gave up so many sources and methods—a blueprint for the adversary." And what would people make of Virtru's NSA pedigree?

MANY THINGS CHANGED after Snowden. Companies whose reputations had been criticized for cooperating with the NSA made privacy a priority. Apple decided to encrypt its new iPhone. Yahoo and Microsoft vowed to secure messages. Google made a similar pledge and started work on its own cryptographic extension for the Chrome browser.

None of this pleased the government, which wanted backdoors added to new encryption to help investigations. Cryptologists loathe the idea. Punching holes in security only creates openings for bad actors, in their view. And tech companies fear their products will never be trusted overseas if they provide entry points for American cyberspies. The debate has been playing out in Congress, while in court the NSA battles lawsuits over its bulk-collection programs.

When Virtru launched in beta in January 2014, awareness about privacy was higher than ever, as was the demand for solutions. Ackerly had no trouble attracting clients. Law firms quickly signed up. So did a range of foreign organizations, including an Australian roofing company, a French semiconductor firm, and an Irish political party looking to secure campaign emails. Virtru integrates neatly with Google Apps for Work, which many small businesses use. For them, encrypted email has often been too costly. Virtru charges $4 per user per month for the professional version of its service, which allows for more control over emails than the free plug-in.

Some experts at firms such as PwC and Gartner have lately been advocating a "data-centric" approach to cybersecurity. As one PwC presentation noted, "Organizations have historically focused on protecting the perimeter to prevent intrusion." If hackers penetrate that perimeter, they can make off

VIRTRU, SAYS AN EX-WHITE HOUSE PRIVACY CZAR, WILL MAKE BULK EMAIL SNOOPING **"IMPOSSIBLE."**

with a trove of unencrypted data. By contrast, data-centric security means hackers have to pry open separate encryption for each piece of data. That makes the approach better suited to what PwC called the "model of open collaboration and trust" that is crucial to business and other endeavors. "It's making the data more usable, more accessible, more user friendly," says Jonathan Katz, the director of the Maryland Cybersecurity Center and professor of computer science at the University of Maryland.

The medical community, including New York's Mount Sinai Hospital, has flocked to Virtru, which lets doctors comply with HIPAA and email patients without annoying third-party portals. It also addresses a bigger problem in the health care industry, which is littered with antiquated systems that can't communicate with one another. Patient data comes from many sources and needs to be portable. Because the TDF wraps attachments as well as emails, medical records can be easily exchanged.

The government of Maryland has signed up for the service, along with the Federal Communications Commission. So has one of America's most prestigious newspapers, which is unwilling to go on the record. The publication wants a way to secure sensitive reportage in the cloud. Capital One and HBO are testing Virtru. The latter wants to use it so that its employees and contractors can collaborate across different platforms and safely share not only emails and documents but also video, audio, and images. "We like the integration of multiple platforms on mobile devices and on different operating systems," says Stephen Fridakis, a vice president of information technology services at HBO. "When you encrypt something, you can say, 'I don't want this forwarded.' We love the fact that it can be revoked. The solution is really portable and not confined to any organization. I can send you an email on your device without you having to think about your public key and my key and doing all these things that are very cumbersome."

And then there is Google. Initially Ackerly was concerned the search giant might not appreciate that Virtru had hacked Gmail. On the contrary, Google executives were impressed. They told Ackerly they'd never

seen anyone integrate with Gmail as he had. (Google declines to comment on specific conversations but did not dispute this characterization.) Google has since turned to Virtru as an encryption partner in a booming new market: storing evidence video from body cameras worn by police officers. Google offers cheap space on the cloud, while Virtru keeps the video safe and reduces liability. Some Google salespeople are recommending Virtru as an encryption solution to their Google Apps for Work customers. As of August more than 2,000 companies using those apps were securing emails with Virtru. Another 1,000 not using the apps also use Virtru.

The company declines to disclose its revenues, but each user of its "pro" product brings in $48 a year; the average company using Google Apps has about 100 employees. The technology should be easily scalable: Virtru stores only encryption keys (at low cost), which keeps overhead minimal. The company says it has 90% gross margins. "All we really pay for is managing the keys," says John Ackerly.

It is John, Will's 41-year-old brother, who is Virtru's CEO, the one focused on running the business. His role frees Will to devote himself to technology—and to periodic flights of fancy. The partnership seems to work, though John, a Rhodes Scholar, Harvard Business School grad, and former private equity executive, can find his patience tested by his brother's ways.

In May, for example, Will disappeared for 72 hours and missed an important sales meeting. John's repeated calls went straight to voicemail. Eventually John discovered that his brother had been holed up in his apartment, a few blocks away from Virtru's offices. John marched over to chew him out, but before he could start, Will—bleary and disheveled after multiple all-nighters—said, "Let me show you something." He spun his laptop around and explained that he had figured out a way to make encrypted emails searchable, something that previously wasn't possible

“LET ME SHOW YOU SOMETHING,” ACKERLY SAID. HE’D FOUND A WAY TO SEARCH ENCRYPTED EMAILS.

on widely used consumer platforms such as Gmail.

Right before launch, Virtru commissioned a Harris poll of more than 2,000 Americans. Nearly half felt restricted in what they could say over email because it might be read by someone other than the intended recipient. But few have taken even the first step to protect themselves.

“Never has this been more timely,” says Nuala O’Connor, the president of the Center for Democracy and Technology, which describes itself as a “champion of global online civil liberties.” Says O’Connor: “We’ve got to make the user interfaces manageable for the ordinary citizen. That’s the tipping point. The guys at Virtru are trying to solve for that.”

O’Connor thinks online behavior will change when simple tools like the TDF are widely enough in use. Ackerly hopes that’s true. Meanwhile the Virtru team continues to add features and polish the product, including prompts to encrypt when a credit card number or other sensitive data is detected.

In August a different sort of overture landed in Ackerly’s in-box. He suspected it might happen one day. The message was from a federal intelligence and security agency. It wasn’t a warrant, and the feds weren’t asking for an encryption key. They weren’t even connecting to chide Ackerly for rolling out strong encryption to the world. No, the government had a different agenda: It finally wanted to use his TDF. ■

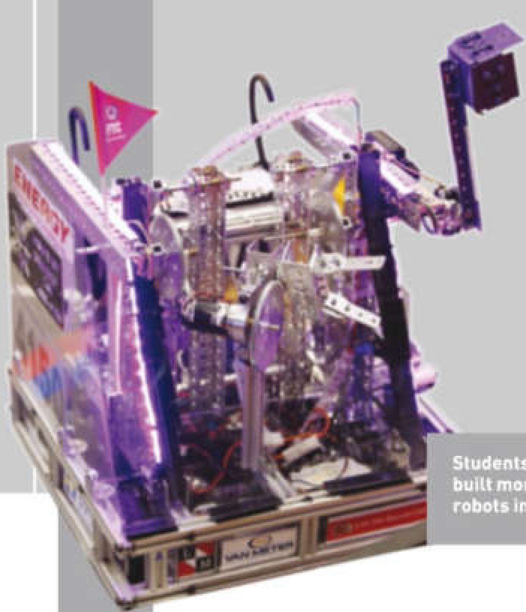
ENGINEERING AWESOME

AFTER 25 YEARS, THE AFTERSCHOOL PROGRAM *FIRST* HAS COME A LONG WAY IN MAKING SCIENCE AND TECHNOLOGY COOL WITH YOUNG PEOPLE.

AS THE INVENTOR of a number of revolutionary biomedical products, Dean Kamen has done a lot to make the world a better place. He holds close to 450 patents. He also invented the Segway. But perhaps his most lasting legacy is the K-12 international robotics program he started in 1989, *FIRST*® (For Inspiration and Recognition of Science and Technology).

The goal of the nonprofit is to help develop youth ages 6-18 into tomorrow's science and technology leaders and innovators, primarily through a series of fun, robotic-building competitions. *FIRST* has grown from 28 teams in the U.S. in the initial competition season in 1992 to more than 44,000 teams and more than 2,200 tournaments in over 80 countries. (The students built 30,000+ robots last year alone.) That amounts to more than 1 million students who have taken part in the competitions over the years; many have gone on to make significant technological contributions in the workplace.

The programs in the United States begin with the Junior *FIRST* LEGO® League program serving youth ages 6-9, followed by the *FIRST* LEGO League program serving youth ages 9-14, the *FIRST* Tech Challenge for students in grades 7-12, and the *FIRST* Robotics Competition serving high school–aged youth in grades 9-12.



Students involved in *FIRST* built more than 30,000 robots in 2014 alone.

The 2015–2016 season's competition introduces a game-changing technology platform in the *FIRST* Tech Challenge program. A new mobile platform features robot and driver-station controls based on Java programming. The platform, which consists of mobile devices, will be powered by Qualcomm® Snapdragon™ processors from Qualcomm Technologies Inc., a subsidiary of Qualcomm Incorporated and a *FIRST* Strategic Partner. Similar to the way in which *FIRST* programs have provided thousands of 3-D printers to its teams, the new Android platform demonstrates the commitment of *FIRST* to utilize the most innovative technologies and to prepare students with relevant STEM (science, technology, engineering, and math) skills for the 21st-century workplace.

Kamen's vision over 25 years ago—to make scientists and engineers as cool as entertainers and athletes—has moved the needle. *FIRST* participants are more than twice as likely to major in science or engineering in college, and female participants are four times more likely to study a STEM subject. Nearly 90% of *FIRST* alumni are in a STEM field as a student or professional. They also learn valuable lessons about team building and mutual respect, gain self-confidence, and develop important leadership and life skills. In addition, the *FIRST* Scholarship Program makes available more than $22 million in scholarship opportunities.

"My goal was to transform our culture by creating a world where science and technology are celebrated and where young people dream of becoming science and technology leaders," says Kamen. "*FIRST* experiences give young people the toolset they need to build an extraordinary life, career, and—ultimately—a better society."

40
UNDER
40
2015

THE BEST ADVICE I EVER GOT

No one gets to the top alone. Every member of the *Fortune* 40 Under 40 relied on the counsel of a broad group of advisers along the way, whether investors, mentors, college professors, board members, or, yes, Mom and Dad. In the following pages you'll read the advice that helped them the most. We also asked our young innovators for their best productivity hacks, what they'd tell their younger selves knowing what they know now, and the CEOs they most admire. Some themes: Don't be afraid, stay away from email, and worship at the altar of Elon Musk.

"You don't fail until you stop trying." –*Charles Falzone* [HER FATHER]

OPEN FOLDOUT TO READ MORE!

LISA
FALZONE
30
REVEL
SYSTEMS

PHOTOGRAPH BY **BENJAMIN RASMUSSEN**

What if you could grow...

while

"'There are a few people who will change your life forever. Find those people.' Not sure [about] the exact origin, but I saw this written recently, and it's similar to something my dad shared with me when I was much younger. It stuck, and means a lot to me."

KAYVON BEYKPOUR, *27*

PERISCOPE

ON PROCESS

DEBBIE STERLING:
"I had a painting teacher who told us to 'kill all your darlings.' Sometimes you get too focused on one small thing that you just love and ignore the rest of your canvas in favor of what is essentially a fairly insignificant piece with a lot of emotional attachment."

YEHUDA SHMIDMAN:
"An executive I met along the way once said, 'Don't confuse activity with progress.' Brilliant—especially in today's world of being constantly over-inundated by emails, texts, and phone calls."

LOGAN GREEN:
"Focus on one thing, and do that really, really well."
—Sean Aggarwal, Lyft's first investor

MICHAEL DUBIN:
"You have to create the quiet to be able to listen to the very faint voice of your intuition."
—Jon Favreau

SAM ALTMAN:
"Make something people want."
—Paul Graham

RESHMA SAUJANI:
"'Fail hard, fail fast, fail often. It's the key to success.' This one I learned from experience!"

TAYLOR SWIFT, *25*

"I THINK THE BEST ADVICE THAT I EVER GOT AS A TEENAGER WAS TO THINK ABOUT YOUR ACTIONS.

PRODUCTIVITY HACK

"Taking **one manda**
my productivity. I re
every few months, a
full day off, I was abl
break that allowed r

ENTERTAINER

Because if you are 80 years old looking back, you know if your dad calls you at eight in the morning and wants to go to breakfast, as a teenager you are like, 'No, I want to sleep,' and as an 80-year-old looking back, you go to breakfast with your dad. It's just those little decisions like that."

AS SAID AT THE 2011 TEEN CHOICE AWARDS

Apoorva Mehta 29, INSTACART

atory day off every week has done wonders for
alized a few years back that I used to burn out
nd it was happening increasingly. By taking one
e to give my body and brain a much-needed
ne to come back to work refreshed."

HEROES

What CEO Do You Admire Most?

ELON MUSK

JAMES PARK

MICHELLE DIPP

LOGAN GREEN

KAYVON BEYKPOUR

ORION HINDAWI

"His ability to build multiple businesses around the most amazing, aspirational, moon-shot ideas is truly inspiring."

HOWARD SCHULTZ

ANDY KATZ-MAYFIELD

JULIA HARTZ

JOSH GOLDIN

MELANIE WHELAN

MICHAEL DUBIN

JOHN ZIMMER

"He's always believed Starbucks is so much more than just a coffee company, and his passion is palpable—in every message he sends to his employees and his shareholders ... I'm also obsessed with their cold-brew coffee."

ALFRED P. SLOAN

PRESIDENT AND CHAIRMAN, GENERAL MOTORS, 1923–1956

"He had a really interesting career and published a great memoir, *My Years With General Motors.* It's a fascinating look at some of the problems one of the first big companies faced."

CHRIS WANSTRATH

BRUCE WASSERSTEIN

DEALMAKER

"Unfortunately, I never had the opportunity to meet him in person, but ever since reading *Barbarians at the Gate* years ago, I always admired 'Bid 'em up,' Bruce's innovative—and BIG thinking approach—to dealmaking."

YEHUDA SHMIDMAN

DELOS COSGROVE

PRESIDENT AND CEO, CLEVELAND CLINIC

"Few leaders have built successful institutions with such large-scale positive social impact."

WILL ACKERLY

BEYKPOUR: NOAM GALAI—GETTY IMAGES; SWIFT: GEORGE PIMENTEL—LP5/GETTY IMAGES; MEHTA: BENJAMIN RASMUSSEN; MUSK: STEVE GRANITZ—WIREIMAGE/GETTY IMAGES; SCHULTZ: VICTOR CHAVEZ—WIREIMAGE/GETTY IMAGES; WASSERSTEIN: DANIEL ACKER—BLOOMBERG VIA GETTY IMAGES; BROWN-PHILPOT: COURTESY OF TASKRABBIT; GOGO: COURTESY OF SPROXIL; CONRAD: JIM WILSON—THE NEW YORK TIMES/REDUX; WHELAN: COURTESY OF SOULCYCLE

JAMES PARK, *39*

FITBIT

“DURING MY FIRST STARTUP, A VC TOLD ME TO SPEND CASH AS FAST AS WE COULD TO GROW.

We took that advice, and the company ultimately went under during the dotcom collapse because we ran out of cash. The advice was terrible in the short term, but it did teach me the importance of good cash management and the importance of driving profitability.

Both of those things served Fitbit really well, given the capital challenges of building a connected hardware company. In a lot of respects, weirdly enough, that was the best piece of advice I’ve ever gotten.”

PHOTOGRAPH BY **BENJAMIN RASMUSSEN**

STACY BROWN-PHILPOT, *39*

TASKRABBIT

"RELATIONSHIPS MATTER."

—*Sheryl Sandberg*

Melanie Whelan

38, SOULCYCLE

PRODUCTIVITY HACK

"Prioritize. **Figure out the few key things that are most important in your role for you to have an impact on your business.** Make these things your sole priorities. It's really easy to fill your time with email and meetings—ultimately this can just be busywork. When you set your priorities on the things that will move the business, your team, or your department forward, you're going to have an impact."

Ashifi Gogo

34, SPROXIL

PRODUCTIVITY HACK

"Avoid bad meetings and the tempting In-Box Zero. Skip email on occasion, pick up the phone, and have a wonderful conversation from time to time. **Memories count.**"

Parker Conrad

35, ZENEFITS

PRODUCTIVITY HACK

"Start drinking coffee—or up your dosage. I was never a coffee drinker until I started Zenefits. **Those first six months were the most productive of my life.**"

ON LEADING

ASHIFI GOGO:
"It came from a ridiculously challenging graduate engineering test that could only be solved by approximation: Many problems can be solved approximately right."

ANDY KATZ-MAYFIELD:
"You have to recognize that every out-front maneuver you make is going to be uncomfortable. That warm sense of everything going well is usually the body temperature at the center of the herd."
—*Irv Grousbeck, professor, Stanford Graduate School of Business*

BRIAN SHETH:
"You aren't going to save the world on your own. But you might inspire a generation of kids to save it for all of us. You would be amazed at what inspired children can do."
—*Jane Goodall*

JESSICA ALBA:
"Never allow a person to tell you no who doesn't have the power to say yes."
—*Eleanor Roosevelt*

FROM MOM AND DAD

RYAN GRAVES:
"You become the company you keep. I originally got that from my parents, and the theme has definitely played out in life."

VAS NARASIMHAN:
"The best advice came from my father, who has always told me to focus on how you live and how you impact the world, and the rest will take care of itself."

RONDA ROUSEY:
"I always go back to my mom's, 'No one has the right to beat you.'"

NOAH WINTROUB:
"From my mom: 'Pick your battles wisely.'"

ORION HINDAWI:
"My father, David, told me something when I was 5 years old—he sleeps great at night because he is honest during the day."

MELANIE WHELAN:
"Growing up, my mother always told my sister and me that if we put our minds to it, we could do it. Whatever it was."

WISH I'D KNOWN

Advice to My 20-Year-Old Self

"Everything that you think is the end of the world right now won't even matter to you in two years."

RONDA ROUSEY

"Relax more."

MICHELLE DIPP

"Take risks while you're young. Embrace frugality to chase your dreams."

LOGAN GREEN

"Stop comparing yourself to others. There will always be someone who seems smarter than you, catches on faster than you, or seems to have everything figured out. Figuring out how to appreciate your unique offering and believing in yourself is so important to unlocking your potential."

DEBBIE STERLING

"The right on-the-job environment will teach you faster than any classroom."

WILL ACKERLY

"Listen more and talk less."

JULIAN STEINBERG

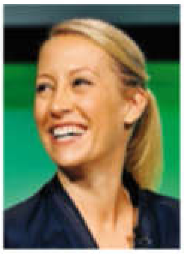
"Find a life partner better than yourself."

VAS NARASIMHAN

"Try to have some fun. Life is about to get a lot harder."

DHIVYA SURYADEVARA

"Stop trying to please everyone. Oh… wait… I'm still telling myself that. :)"



JULIA HARTZ, 35

EVENTBRITE

"Whenever you feel that hesitation to resist trying something new or doing something that feels out of the ordinary, ignore it."

KAYVON BEYKPOUR

"Stop worrying so much about what you should be doing and focus more on what you want to be doing. Also, lose the gold chain."

ANDY KATZ-MAYFIELD

BARRA: DAVID PAUL MORRIS—BLOOMBERG VIA GETTY IMAGES; HARTZ: STEVE JENNINGS—GETTY IMAGES

HUGO BARRA, 38

XIAOMI

"LEARN MANDARIN. TRUST ME."

ADVERTISEMENT

ONE FAMILY. ONE CALENDAR.

Manage the chaos of everyday life with Cozi, the must-have app for families.

- Keep track of the new fall schedule and everyone's activities, all in one place
- Share grocery, chore, and to-do lists in real-time
- Access and update from any mobile device or computer

in iTunes® and Google Play™

GET IT FOR FREE AT COZI.COM

cozi™

Family life. Simplified.

Date: 10/1/15

Contamination Nation

Written by
Beth Kowitt

Despite big advances in science and huge investments by companies, food-borne illness still gets 48 million people sick each year—and costs the industry billions of dollars. Here's why, and what we might do to solve it.

Serving size: **319 million American consumers**

Known food-borne pathogens: **31**

Food recalls in 2014: **659**

Annual cost of treatment, lost productivity, and mortality: **$55.5 billion**

Allow us, just for a moment, to be completely—and irresponsibly—alarmist: We are in a battle with bacteria. And from the numbers, it might well appear that we are losing.

Each year an estimated 48 million Americans are stricken ill as the result of one food-borne pathogen or another—listeria, *E. coli*, salmonella, and even a number of stowaway viruses are among the culprits. But in many cases the victims don't know they've been infected. For those who go to a doctor or the hospital, the collective bill is substantial. A 2015 study by Robert Scharff, an associate professor at Ohio State University, estimates the annual cost of medical treatment, lost productivity, and illness-related mortality at $55.5 billion. For lack of a good Latin name for the constellation of ailments that fall into the above category, we'll call the pathology "getting sick from what you eat." And the scariest part is, that's about as precise as the medical explanation often is. "The route by which most of these individuals get ill is unknown," says John Besser, the deputy chief of the Enteric Diseases Laboratory Branch at the Centers for Disease Control and Prevention.

That's not just a scary prospect for those of us who are consuming food these days (that's you, dear reader), but also for those who are making and selling it. Food-borne illness is a giant, expensive challenge for companies big and small—and the surprise is, their exposure to the risk (and the liability when linked to an outbreak) is arguably bigger than ever. "Thirty years ago if you had a little problem, you were not going to get discovered," says David Acheson, former associate commissioner for foods at the U.S. Food and Drug Administration, who today runs a consulting firm. "Now the chances of getting caught are significant, and it can be the end of your company."

Photograph by **Henry Hargreaves** Styling by **Caitlin Levin**

Or a costly wound, at the very least. When the Grocery Manufacturers Association surveyed three dozen international companies in 2011, more than half reported being impacted by a food recall during the previous five years. Eighteen percent of those said the hit from the recall and lost sales was between $30 million and $99 million; 5% said the financial impact was $100 million or more. The long-term reputational damage to companies can have an even steeper price tag.

To help solve the problem, in mid-September the FDA released the first set of major rules it was instructed to create by the Food Safety Modernization Act (FSMA), passed long ago in 2011. But honestly, new regs alone won't solve this problem. Here are four reasons the food-poisoning conundrum is so hard to solve.

1. Health officials can identify only a fraction of those who get food poisoning.

Pinpointing an outbreak of food-borne illness is largely a matter of luck and circumstance. It can take dramatic symptoms for people to visit a doctor, and even then, physicians seldom order a stool sample—the prime way to trace a pathogen to a patient. If a specific germ is found to be the cause, public health authorities may then interview the person to determine what he's eaten (in the case of listeria, investigators might require a record of food consumption that goes back 28 days). And, well, people forget what they eat. Then epidemiologists have to take this indeterminate recollection of meals and snacks—something that might include hundreds of components—and isolate the source of the culpable microorganism.

None of this is easy. Most cases of food-borne illness are sporadic, meaning they cannot be traced to a specific "outbreak"—an event known to have caused illness in others. Even in the case of an outbreak, it's woefully hard to identify those who fall ill. For example, out of every 29 people who get sick from a typical salmonella outbreak, the CDC estimates that just one will be formally diagnosed.

Given such long odds, it's somewhat remarkable how many outbreaks have been isolated in recent years—particularly in cases in which foods and germs were linked together for the first time. For instance, since 2006 investigators have fingered a bacterial strain called *E. coli* O157:H7 (at one time widely thought to be found only in meats) in bags of baby spinach, in hazelnuts, and in cookie dough. They've identified botulism in pasteurized carrot juice and found salmonella in peanut butter, ground pepper, jalapeño peppers, Turkish pine nuts, and pistachios. They've discovered hepatitis A virus in pomegranate seeds; cyclospora in bagged salad mix; and *Listeria monocytogenes* in ice cream. (See our companion story on Blue Bell on page 122.)

GROWTH IN RECALLS

"I'm skeptical that these are new connections," says Ben Chapman, associate professor of food safety at North Carolina State University, who runs a website called the Barfblog. "It's stuff that's always been there, and now we're looking for it." That would help explain why FDA-regulated food recalls have more than doubled over the past decade, to 565 last year, according to insurance company Swiss Re—with nearly half related to microbiological contamination. In interviews with more than 30 experts, nearly all said the rise in recalls was less an indicator of deteriorating food safety than it was of our improving capacity to connect the dots between foods and microbes.

2. Regulators have new tools. Industry doesn't trust them.

Up until the 1990s, most outbreaks we found were in the same geographic location—the church picnic where everyone eats the same bad potato salad and calls in sick the next day. Then new technology enabled scientists to determine the various DNA fingerprints of food-borne bacteria, which were uploaded into a common database. Investigators were suddenly able to link disparate cases of illness by finding bacterial matches. "It revolutionized outbreak investigation," says Linda Harris, a microbiologist in the department of food science and technology at the University of California at Davis.

Since then the tech has gotten faster and more accurate—a fact that has allowed for the creation of large databases of bacterial genome sequencing. The CDC is building its own library of pathogen genomes isolated from patients. The FDA is doing the same with microbes found in food and company production facilities, a program it calls GenomeTrakr.

Major food companies, meanwhile, commonly test for bacteria in their own food and factories. (Bacteria are everywhere: On each square centimeter of your skin there are potentially millions of the tiny organisms. Worry not—nearly all of them are harmless.) And when companies find any worrisome strains, they increasingly do genetic analyses of their own. It would make sense, certainly, for them to contribute their own data to GenomeTrakr—which is something the FDA strongly encourages. (The word

GRAPHIC SOURCES: SWISS RE; USDA; FDA

"encourage" here is in the softest sense: Companies are really required to report only contaminations of products that could cause a public health issue.)

But many food manufacturers are wary of giving regulators any information they don't have to. "There's clearly a nervousness around it," says Acheson. "If a company has got data that could incriminate them in an outbreak, they get reluctant to look for it. It's a very fine line."

The concern is twofold: First, these techniques are imperfect. Not all genomic sequences of linked food and patient pathogens will have exact matches. "There's a range of relatedness," says Carlota Medus, an epidemiologist at the Minnesota Department of Health. "The new advancements are more specific," says Elisabeth Hagen, a former undersecretary for food safety at the U.S. Department of Agriculture who is now a senior adviser to Deloitte. "But there are reasonable questions about what constitutes a match and how the technology will be used to definitively identify the source of an outbreak."

The second worry is that regulators will shoot first and ask questions later. Companies fear they will be implicated before the necessary epidemiology is done. "They could send a SWAT team into a plant, and the business is going to be disrupted significantly," says Mike Robach, vice president of corporate food safety, quality, and regulatory affairs at Cargill. "We just want to make sure we have due process and are not falsely accused."

One potential solution is VoluntaryNet, which is run by Michael Doyle at the University of Georgia's Center for Food Safety. Currently Cargill and other companies anonymously submit bacteria samples that might cause food-borne illness to Doyle's team, which genetically sequences them. If the university researchers discover a match with a genetic isolate from a patient in the CDC database, they send a report to *all* the food companies in the network, letting them know of a potential contamination link.

3. Our pantry is global. [So are the chances for contamination.]

Americans love strawberries—we annually consume about eight pounds of them per capita—and we want them year round. The berries we can't get from U.S. growers we bring in from Mexico, mostly. Overall we import nearly 20% of our food—and each of these exporting countries has different food-safety standards and inspection regimes.

GRAPHIC SOURCE: SWISS RE

The global supply chain has not only given us a cornucopia of food choices; it has also cut costs. The downside is that it has made preventing food-borne contamination nearly impossible. By the time milk tainted with melamine produced in China was detected, it had already been exported to 47 countries by way of milk-containing products.

The more stops food takes before it enters the U.S., the more opportunities there are for contamination, says Bill Marler, an attorney and an oft-cited authority on food-borne illness. Companies now fret about so-called economic adulteration, in which suppliers in some cases add something to food that shouldn't be there—as occurred with the melamine scandal in China, when the chemical was put in diluted milk to increase its protein content. This form of food fraud—which happens most prevalently in liquids like olive oil and in powders such as spices—costs the industry $10 billion to $15 billion a year. "I'm not sure we truly worried about this 20 years ago," says Sara Mortimore, vice president of product safety, quality, and regulatory affairs at Land O'Lakes. And for companies, the stakes could get much higher: Additional FSMA rules anticipated later this year are expected to hold importers responsible for whatever they bring into the country.

4. Oh, yeah—and it's our fault too.

Increasingly, consumers are rebelling against preservatives—fearing those additives intended to prevent food poisoning more than the sickness itself (see our special report, "The War on Big Food," on Fortune.com). Cargill's Robach says a number of customers have asked the company to remove the potassium and sodium lactates and diacetates it puts in processed meat to inhibit listeria growth. "We have not taken it out because we feel there's an added layer of protection that's important," he says.

A growing segment is also pressuring manufacturers to cut back on salt and sugar—both of which help prevent bacterial growth by reducing the amount of available water in food that the microbes can grow in. Then there's freezing, which also boosts food safety. But today's shoppers are turning away from frozen food because of a desire for fresh goods, which they equate with healthy.

Some food companies are experimenting with techniques like high-pressure processing, which

squashes the bacteria on the surface. But it can impact quality. “You can’t do that with a tomato,” says Acheson. A similar concern is voiced over food irradiation, which is even more off-putting to many than sugar, salt, and preservatives.

Ironically, trying to eat more fruit and vegetables—especially raw—can be the riskiest thing of all. We eat them without performing what food-industry vets call a “pathogen-reduction step.” Most of the rest of us call it cooking.

Is there a solution?

Pizza is perhaps the best example of why our regulatory structure is a challenge. “It’s very confusing,” says Secretary of Agriculture Tom Vilsack, who visited *Fortune* in mid-September. “If it’s a plain pizza with tomato sauce, mozzarella, crust, it’s the FDA. If it’s a slice of pepperoni, it’s mine. Sausage, it’s mine. Mushroom, it’s theirs.” Indeed, it is hard to conceive of a more haphazard regulatory regime than the one intended to protect Americans’ food. The USDA regulates meat, poultry, and processed egg products and has an agent in every processing plant in the U.S. The FDA minds everything else but requires no testing of food from manufacturers. That’s not to suggest that testing is the obvious cure-all for our seemingly endemic food-safety predicament. “If you take a whole bunch of lettuce heads off a truck and test one out of 100, you still might not find a problem because it’s not likely to be spread evenly,” says North Carolina State’s Chapman. “We could have a really big sampling program and never find a pathogen.”

That’s why regulators—and companies—are focusing more on prevention. The new FSMA rules, indeed, mark a big regulatory shift: one that mandates companies take a more proactive approach to food safety rather than wait for an outbreak to trigger a frantic cleanup response. “Instead of the FDA having to show that firms are doing something wrong, firms have to show that they’re doing something right,” says Charles Breen, a former FDA district director who is now a food-safety consultant.

As for consumers (again, that’s you): Use a meat thermometer, wash your hands, don’t drink raw milk. Those in the know also suggest being especially wary of items like oysters, sushi, and sprouts. Bill Marler, for one, routinely chucks the bagged salad that his wife buys. “I will grab it out of the refrigerator and throw it away,” he says. What’s the safest thing to eat? That’s easy, he says. Scotch.

10/1/15 BY PETER ELKIND

How Blue Bell Blew It

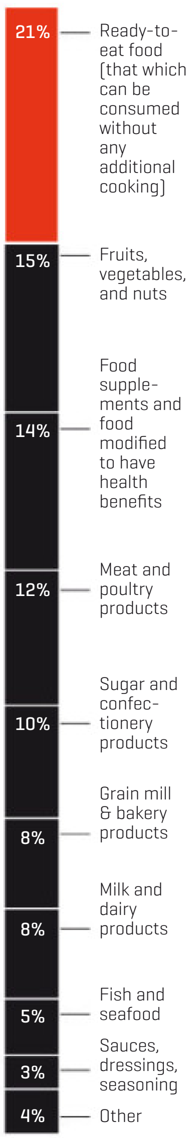
AN ICE CREAM MAKER’S CONTAMINATION EPISODE SHOWS THE LIMITS OF THE FOOD-PROTECTION SYSTEM—ESPECIALLY WHEN THE COMPANY IS SLOW TO COME CLEAN.

E**arlier this year** disaster struck Blue Bell, the nation’s third-largest ice cream maker. The Centers for Disease Control and Prevention linked its desserts to 10 infections, including three deaths, forcing it to shut down production in April and recall all its products from 23 states.

Diehard fans of the 108-year-old, family-run operation went into mourning—but more for Blue Bell than the victims. In Brenham, Texas, site of its headquarters and a company town of 16,000, residents held a prayer vigil in the town square. On the presidential

MEENU BHARDWAJ—THE NEW YORK TIMES/REDUX

FOOD MOST AFFECTED BY RECALLS



GRAPHIC SOURCE: SWISS RE

campaign trail, Texas Senator Ted Cruz posed for a photo with a sign reading: GOD BLESS BLUE BELL.

Lost among the laments was the fact that Blue Bell had found listeria—the bacteria implicated in the outbreak—in a plant two years earlier but failed to solve the problem. And what was identified as an infection outbreak in 2015 was actually sickening people as early as 2010.

The episode reveals not only how difficult it is to trace the source of food-borne illness but also what happens when a company is slow to tackle the causes—and doesn't come clean with its customers. Experts say Blue Bell's responses this year were an example of "recall creep." That occurs when executives hope that taking limited action—as the company did five times when informed of findings of listeria—will solve the problem and minimize commercial damage, only to find themselves forced to expand the recall repeatedly. It's the opposite of Johnson & Johnson's actions in the 1982 Tylenol-tampering episode, when the brand famously saved its reputation by swiftly recalling every bottle of the medication.

Citing pending litigation, Blue Bell declined requests for interviews. (The company resumed limited sales on Aug. 31.) "If you have listeria persisting in a plant, one of the mandates is to root it out," says Craig Hedberg, a food-safety expert with the University of Minnesota's school of public health. "If it's there and you don't, it's pretty clear you've failed to do your duty to your customers."

Blue Bell is beloved in the South—in part because it has masterfully marketed itself as

Experts call Blue Bell's initial piecemeal responses "recall creep."

a small-town family business whose ice cream is a labor of love. "We eat all we can, and sell the rest," went one longtime slogan. Blue Bell promoted its products as coming from "the Little Creamery in Brenham," even as production expanded to four factories and annual sales, according to Euromonitor International, grew to some $880 million.

The problems started to emerge on Jan. 28, when tests by South Carolina state inspectors revealed *Listeria monocytogenes* in two products made in Blue Bell's flagship Brenham plant. (*Listeria monocytogenes* is the bacteria that causes listeriosis, blamed for 1,600 serious infections a year, including 260 fatalities. Listeriosis is the third-leading cause of food-borne death in the U.S.)

Using a nationwide bacterial registry, the CDC matched the Blue Bell bug to listeria strains blamed for an unsolved 2014 outbreak at a Wichita hospital: Five patients, already hospitalized with serious illnesses, had been infected; three died. Investigators later confirmed that four drank milkshakes made with Blue Bell ice cream. Further testing would link the company to 10 listeriosis cases dating back to 2010. Experts believe there are many more illnesses where the connection will never get made.

Blue Bell executives first learned about the listeria finding in South Carolina on Feb. 13. Three days later the company began retrieving 10 different products made on the same factory line—without any public announcement that it had sold a tainted product. (Neither the FDA nor state regulators insisted on disclosure, reasoning that the only two products then known to contain listeria were single-serving items. These items tend to be sold to institutions and convenience stores, which meant they were in a limited number of places and could be retrieved.)

Blue Bell learned on March 9 that the listeria strains identified in South Carolina had been linked to the deaths in Wichita. The next day it stopped making ice cream on the tainted Brenham production line. It later shut the machine down permanently.

On March 13, Blue Bell announced a recall, "the first … in 108 years." Actually, the company was just making public the steps it had already taken a month earlier. Blue Bell explained that it had pulled "a limited amount" of frozen snacks with "a potential listeria problem," while emphasizing that the action "in no way" involved its other products.

On March 22, Kansas authorities advised Blue Bell they had found more listeria at the Wichita hospital—in a three-ounce chocolate ice cream cup. This item had been made in Oklahoma, extending the problem to a second plant. Blue Bell responded with statements acknowledging the Kansas deaths for the first time, expressing regret and adding ice cream cups made in Oklahoma to the recall.

By April 3 the CDC had linked the bacteria found in the chocolate cup with five more listeriosis cases as far back as January 2010. Citing "an abundance of caution," Blue Bell announced it was "voluntarily" suspending all manufacturing in Oklahoma to "thoroughly inspect" for any possible contamination sources.

On April 6 the CDC recommended that consumers "not eat" any product made at the Oklahoma plant. That day Blue Bell announced it was "voluntarily withdrawing" everything made there, insisting: "It is important to note that these products HAVE NOT BEEN RECALLED." A day later the FDA notified Blue Bell that it had found listeria in another flavor made in Oklahoma. Blue Bell then announced a "recall" of seven more flavors—which it was already pulling as part of its "withdrawal."

On April 20, after more listeria was found in tubs of Chocolate Chip Cookie Dough ice cream made in Brenham, Blue Bell finally recalled all its products. CEO Paul Kruse apologized, saying everyone at Blue Bell was "heartbroken." Although the company had "initially believed this situation was isolated to one machine in one room," he explained, "we now know that was wrong." He said the company had hired "one of the world's most respected food-safety microbiologists" to "get to the bottom of this issue."

In fact, Blue Bell knew it had a listeria problem two years earlier. The FDA released inspection reports showing that the company had found the bacteria in its Oklahoma plant, on surfaces such as floors and catwalks, on 17 occasions beginning in March 2013. Despite this, the FDA found, Blue Bell hadn't followed up "to identify sanitation failures and possible food contamination," taken proper steps to root out the problem, or informed the agency of its findings. FDA inspections of multiple plants, starting in March, found not only listeria but also condensation dripping from machinery into ice cream and ingredient tanks; poor storage and food-handling practices; and failures to clean equipment thoroughly.

Immediately after its national recall, Blue Bell spoke of cleaning up in a few weeks, then resuming sales. It soon became clear that was wildly optimistic: Blue Bell's plants and practices required a massive and expensive overhaul. Kruse announced drastic measures. Blue Bell would lay off 1,450 of its 3,900 employees and furlough 1,400 more. Even this wasn't enough. Only a $125 million loan commitment from billionaire Sid Bass kept it from going under, according to a letter Kruse wrote to the private company's shareholders, first reported by the *Wall Street Journal*.

Blue Bell signed agreements with state regulators promising stringent new safety procedures, including that all ice cream be sampled and found bacteria-free before being released for sale. According to the company's website, it has "thoroughly cleaned and sanitized" its facilities and retrained its workers. With regulators' blessing, Blue Bell resumed production in Alabama in July, then in Oklahoma in September. No date has been set to restart the two Brenham plants.

Blue Bell has been criticized for its failure to apologize more fully or explicitly acknowledge those sickened by its ice cream. But Gene Grabowski, a consultant who helped map Blue Bell's PR response, defends its approach. "In my playbook, you apologize sincerely once and then you move on." (He has been supplanted by a team from PR giant Burson-Marsteller led by Karen Hughes, who served as a top White House communications adviser to George W. Bush.) "Had the company known then what it knows now," Grabowski says, "it would have done a full recall of all products earlier than it did."

Blue Bell's plan for a five-stage comeback anticipates a smaller footprint, slowly expanding into 15 states, instead of the previous 23. Even as the company struggled to banish listeria from its plants—and deal with civil litigation and possible regulatory penalties—it built excitement over its return. Blue Bell staged a daily Instagram reveal of the first flavors it planned to reintroduce on Aug. 31. This generated giddy media coverage—and social media ecstasy: "thank baby Jesus," wrote one fan. Vowed another: "I'll be at Walmart at midnight." ■

RECALL COST TO BUSINESS

ESTIMATES INCLUDE DIRECT COST AND LOSS OF PROFIT (U.S.)

GRAPHIC SOURCES: SWISS RE; GROCERY MANUFACTURERS ASSOCIATION

First Lady Michelle Obama greets students in Siem Reap, Cambodia, March 21, 2015.

Official White House Photo

THE FIRST LADY OF THE UNITED STATES, MICHELLE OBAMA, on behalf of the Let Girls Learn initiative, participated in the Fortune Most Powerful Women's Summit on October 13.

With more than 62 million girls around the world not in school, Let Girls Learn seeks to develop solutions to provide adolescent girls with the opportunity to go to school and stay in school, including providing new training to Peace Corps Volunteers as they break down barriers to girls' education.

But, the U.S. government cannot solve this problem alone. Many organizations are stepping up to help support Let Girls Learn in a variety of ways.

See how you or your organization can help by visiting
letgirlslearn.peacecorps.gov

PEACE CORPS

LET
GIRLS
LEARN

SOUTHWEST'S

FLIGHT

THE MAVERICK AIRLINE BECAME THE INDUSTRY'S BIGGEST SUCCESS STORY BY GOING ITS OWN WAY. ITS LATEST STRATEGY? OPERATE MORE LIKE ITS TRADITIONAL RIVALS.

RADICAL NEW PLAN

BY SHAWN TULLY

PHOTOGRAPHS BY NANCY NEWBERRY

Southwest Airlines CEO Gary Kelly inside a mock plane at the company's training facility near its headquarters next to Love Field in Dallas

IF YOU WANT TO UNDERSTAND the nonconformist culture of Southwest Airlines, you've got to start with its holiest site: the shrine to Herb. Walk into the company's headquarters, located in a five-story gray building next to the Love Field airport in Dallas, go past the front desk, and proceed down a broad hallway until you get to a horseshoe-shaped employee lounge with a soaring atrium. There you'll find a museum of sorts honoring Southwest's Wild Turkey–swilling, Marlboro-smoking co-founder and former CEO, Herb Kelleher. In one towering poster on the wall he's shown hamming it up in a sequined Elvis costume; in another he's arm wrestling an aviation rival for charity. Push a red button and you can hear a recording of three versions of Kelleher's famous laugh—the guffaw, the chortle, and the roaring belly buster. On the walls there are embossed plaques with a selection of his favorite sayings, none more emblematic than this gem: "If you rest on your laurels, you'll get a thorn in your butt."

The voluble Kelleher, now 84, no longer gives interviews but still comes to the office on a regular basis—and his legend looms large at Southwest. Starting with just four planes flying to three Texas cities on June 18, 1971, Kelleher built a maverick operation that prided itself on charting a different route from other airlines. It wooed passengers with ultra-friendly onboard service, squeezed more flights a day from every plane, and made money not by raising fares but by lowering them—and hence filling seats with folks who could never before afford to fly. Kelleher's company created the template for other low-cost airlines to follow.

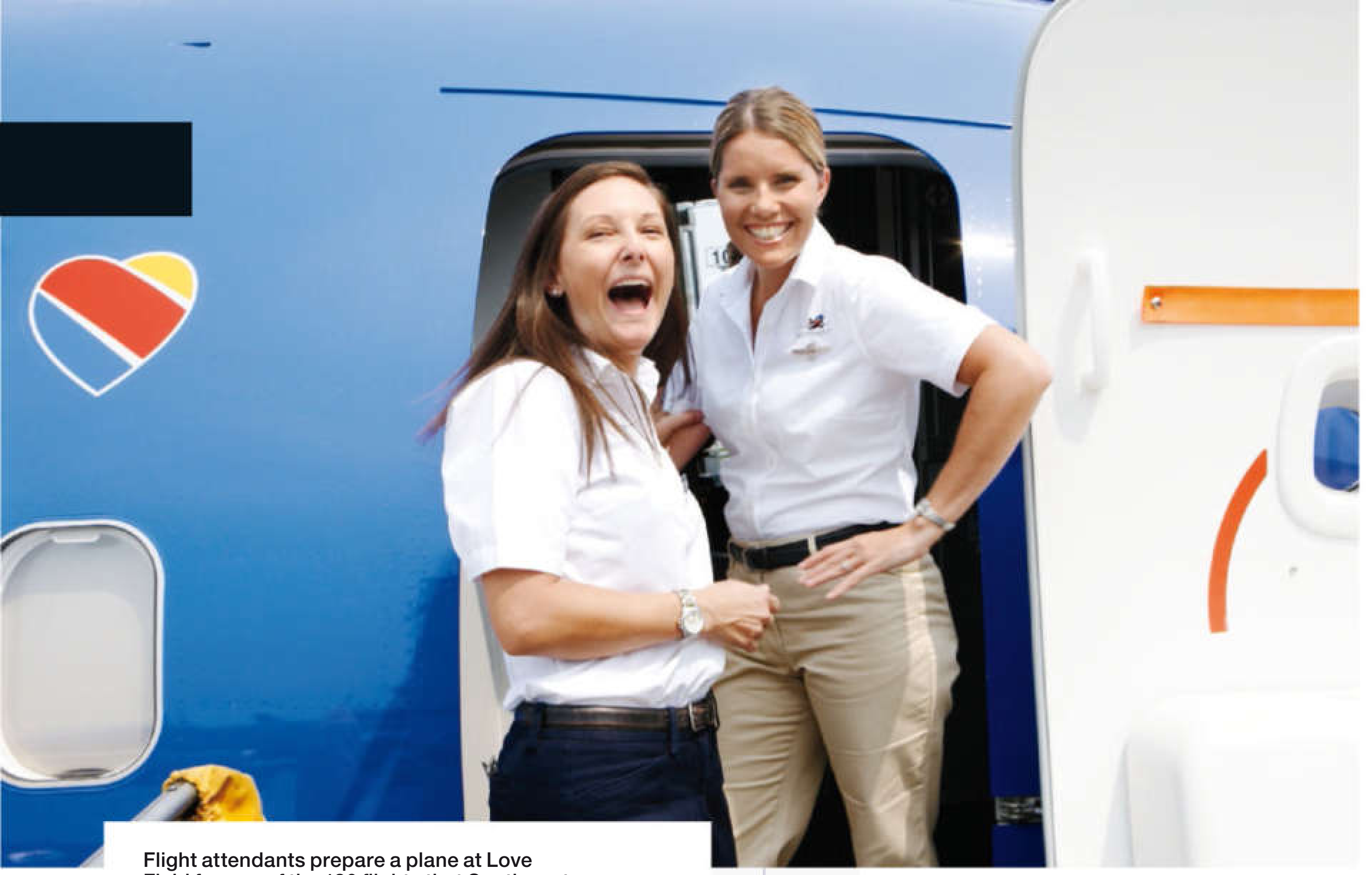
Along the way Southwest evolved from an upstart to a colossus that last year carried 134 million passengers in the U.S., more than any other airline and some 20% of the total. In an industry in which every other major company has gone through bankruptcy, Southwest has never gotten close to Chapter 11 and has made money for 42 straight years. Since it was listed on the New York Stock Exchange in 1977, the airline's stock has delivered 17.5% average annual returns compared with the 11% average gain for the broader market over the same span. In 2014, Southwest was the top-performing stock in the S&P 500, posting a 122% return.

So how has Southwest responded to such a period of extended success? Let's just say that there won't be any thorny derrieres in the airline's executive suite anytime soon. The company is in the process of reworking or jettisoning altogether much of Kelleher's tried-and-true strategy—with plans to fly in a totally new strategic direction. In fact, after years of consistently outsmarting and outperforming the traditional carriers, Southwest is today remaking itself to operate more like them.

For decades Southwest has flown mainly to small airports in big urban markets, where it faced weak competition and could quickly turn around its planes from landing to takeoff. Now it's invading America's biggest, most-congested airports and going nose-cone-to-nose-cone with its newly resurgent big rivals—American, Delta, and United Continental—where they're strongest. The goal? To attract more of the most lucrative customers: high-fare-paying business travelers flying long distances. "Southwest still has a unique personality, but it's flying more and more in formation with the Big Three," says Michael E. Levine, a professor at the NYU School of Law and a former top executive at Continental and Northwest.

The architect of this new strategy is no outsider. Rather it's Gary Kelly, 60, a 29-year Southwest veteran who's served as CEO since 2004 (and is revered enough at the company that he has earned his own mini-museum almost as large as Kelleher's). The big challenge, says the strapping 6-foot 4-inch Texan, is that Southwest's traditional business—short-haul flights between such cities as Dallas and Houston, or San Francisco and Los Angeles—has declined sharply in recent years and now grows modestly at best.

Southwest's best opportunities for expansion and profits are in long-haul business travel now for two reasons, explains Kelly. First, long haul is the biggest, fastest-growing segment in U.S. air travel. Second, it's an area where Southwest is relatively small and that is dominated by the legacy carriers Southwest beats everywhere else. That means there's a lot of market share for Kelly's airline to go after. "We had to call an audible, and



Flight attendants prepare a plane at Love Field for one of the 180 flights that Southwest operates daily out of its home-base airport.

pivot from being so totally dependent on short haul and leisure," says Kelly, sitting in his office filled with Lone Star memorabilia, such as a copy of the 1836 Texas Declaration of Independence. "If you're going to grow, you need universal appeal."

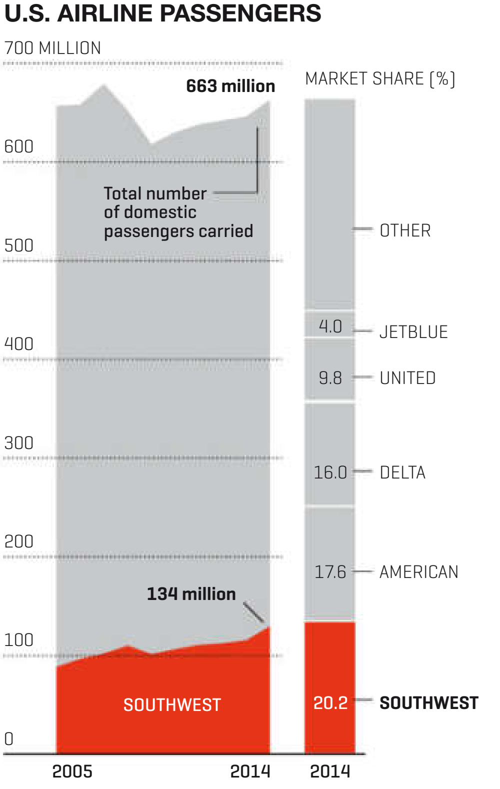
The success of Kelly's new flight plan is far from certain. Southwest has long held a wide cost advantage over its rivals, but that gap has narrowed dramatically in the past few years. The traditional carriers are now a lot bigger and more efficient than at any time in Southwest's history. Since the mid-2000s they've engaged in bankruptcy restructurings and epic mergers that have both substantially lowered their costs and bolstered their leverage in the top business markets.

Just as daunting for Southwest as its newly tough competitors, say some industry observers, is the challenge that Kelly's airline faces in trying to reinvent itself without losing its edge. Southwest has made an art form of no-frills travel, but it has little experience wooing business travelers with generous perks. In behaving more like its rivals, the perpetual underdog risks becoming a member of the club—a profitable but average performer whose fortunes wax and wane with the overall industry.

Kelly dismisses any suggestion that Southwest is mimicking its competitors. His airline will remain on top, he says, by deploying its traditional advantages in the big-city business market. "We'll take customers from the legacy carriers," Kelly

LOW-COST COLOSSUS

As the dominant discount airline, Southwest now moves a fifth of all U.S. passengers.



GRAPHIC SOURCE: U.S. DEPARTMENT OF TRANSPORTATION

declares confidently. "Our service levels are the best in the business, our costs are the lowest of the majors, and our beloved brand puts us in a prime position. We'll grow faster than they will."

WALL STREET IS NOT QUITE as sanguine about Southwest's revamped strategy or its ramifications for the rest of the industry. In fact, earlier this year talk of the airline's expansion plans spooked investors and helped spark a sector-wide selloff.

On May 19, Southwest made the seemingly innocuous announcement that it was raising this year's goal for additional capacity from 7% to between 7% and 8%. (Capacity is defined as available seat miles, or the total miles flown by every seat on every plane throughout the year.) That same day, Doug Parker, CEO of American Airlines, the world's biggest carrier and Southwest's archrival in the Dallas/Fort Worth market, launched a salvo at discount carriers, stating that American would match any fare the low-cost airlines could muster and fight to keep them from poaching American's customers.

The combination of Kelly's new forecast, modest though the increase was, and Parker's challenge to discounters spread fears that the industry was returning to its bad old ways of buying too many new planes and adding seats far faster than it could sell tickets. That cycle brought collapses in fares and stock prices many times before. By the following day shares in Southwest, American, and United had all dropped about 12%, erasing roughly $10 billion in market value; shares of Delta, which is less involved in the Texas price wars, fell too but not as steeply. Kelly quickly trimmed his capacity forecast back to 7%. But Southwest's stock and those of its big rivals—other than Delta—remain below their highs from last spring.

There are other reasons to be concerned that a period of sustained health for the airlines could be coming to an end. At an industry conference in early June top execs addressed the growing angst over a revival of the industry's hobgoblin: unbridled battles for market share. The leaders, including Parker, American's CEO, trumpeted that the industry had learned its lesson in avoiding price wars and expected that the carriers would keep exercising "discipline" by limiting growth in capacity. Weeks later the U.S. Department of Justice confirmed that it was launching an investigation into "possible unlawful coordination among airlines."

The industry's critics argue that the recent spate of mergers has led to unprecedented concentration: The top four airlines now fly three-fourths of all the seats offered in the U.S. market. Though price wars frequently erupt, it appears to many that the airlines are not competing as hard as they would if more big carriers were battling for passengers on the same routes. Case in point: Jet fuel prices dropped 35% in 2014, yet average airfares actually rose slightly. "Increased concentration has pushed up prices," asserts Chris Sagers, an antitrust expert at Cleveland State University. "When you have just two competitors on a route, and that's the case on many routes, competition tends to be muted."

On close inspection, Southwest's growth ambitions are unlikely to be the factor that undermines the industry's newfound profitability. Although Kelly plans to expand faster than his competitors, he won't do so the way investors dread—by purchasing lots of new planes and flooding the market with seats for sale. On the contrary, most of Southwest's growth will come from two factors. The first is a great one-time opportunity: Southwest's new freedom to finally fly long-haul routes from its home base in Dallas. (More on that breakthrough later.) The second is the campaign to attract business customers. That will indeed add more flights and seats on long-haul routes, but Southwest is also trimming unprofitable flights, so its total capacity will increase only modestly.

TO BETTER UNDERSTAND why Kelly feels compelled to mess with his airline's winning formula, it helps to drill down into the numbers. Specifically, let's compare Southwest's financial performance for the first six months of 2012, when the industry was emerging from the recession, with the same span this year, a fantastic period for the airlines. For the six-month period ending June 30, 2015, Southwest posted an operating margin of 19.6%, more than triple the number in 2012, and the highest figure since 1980.

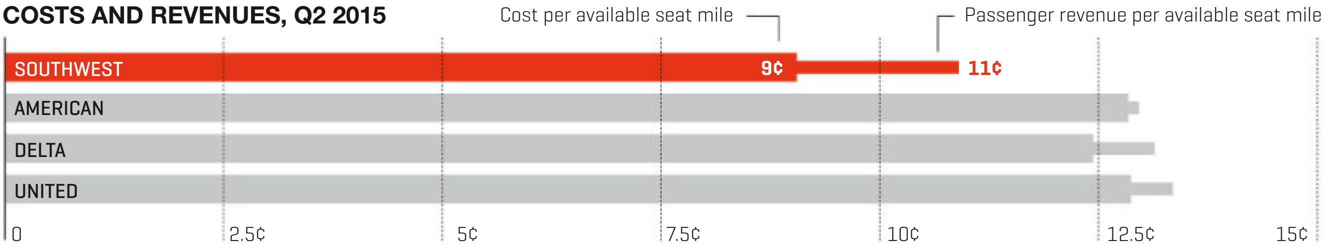
That sounds great on the surface. But let's dig deeper. Southwest maintains about a 25% advantage in costs over the network carriers, measured on cost per available seat mile, or CASM, the expense of flying one seat one mile. The rub is revenues. According to Barclays, Southwest's revenues for one passenger flown one mile are as much as 20% lower than its rivals' on long routes. "Southwest is a cost leader and revenue laggard," says David Fintzen, a Barclays analyst.

"IF YOU'RE GOING TO GROW," SAYS SOUTHWEST CEO GARY KELLY, **"YOU'VE GOT TO HAVE UNIVERSAL APPEAL."**

COST LEADER, REVENUE LAGGARD

Southwest has the lowest costs of the four biggest airlines for trips of similar length, as measured by the cost of flying one passenger one mile. But it lags in revenue collected for those seats. Its strategy? Close the revenue gap by attracting more high-fare business passengers.

COSTS AND REVENUES, Q2 2015



Airlines' costs fall into three main categories: labor, jet fuel, and "all other," which is chiefly the cost of buying, leasing, and maintaining aircraft. Over the past three years, Southwest's labor bill jumped $663 million, or 28%. In fact, Southwest's edge in salaries, wages, and benefits over its big rivals has pretty much disappeared as the legacy carriers have come out of bankruptcy with more company-friendly labor deals.

Southwest has always done a brilliant job controlling its costs in the "all other" bucket, largely because of its unique approach to managing its fleet. It's the only major airline that flies primarily one basic type of plane. Almost its entire 689-plane fleet consists of Boeing 737s in two varieties, the 737-700 and the newer 737-800. The single-aisle models are close to identical, except that the newer 800 model contains more seats than the 700—175 vs. 143. Using one plane produces big savings in pilot training and maintenance.

The company also gets more work out of each plane than other major airlines. While the so-called network carriers like Delta and American funnel most of their passengers through gigantic hubs where they connect to dozens of destinations, mostly in midmorning and late afternoon, Southwest primarily flies nonstop "point to point" routes evenly through the day. That smooth flow of traffic enables Southwest to keep its planes and crews in the air nine hours a day on average, beating its rivals' airtime by two hours. "That's like getting one airplane in five for free," says Randy Babbitt, Southwest's chief of labor relations.

Southwest also has a history of skillfully hedging its exposure to swings in the price of jet fuel, a Kelly specialty. In the mid- to late-2000s, Southwest saved several billion dollars by locking in years of supply at bargain prices as oil soared to over $100 a barrel. But when prices plateaued at high levels, Kelly—figuring they had pretty much peaked—sharply reduced purchases in the futures market. So when prices began to plummet last year, Southwest took only minor losses on hedges and pocketed most of the cost savings. In the first six months of 2015 it spent just $1.88 billion on jet fuel, compared with $3.1 billion over the same period in 2012, a savings of 39%.

When that windfall is excluded, Southwest doesn't look like such a champ for its performance in the first six months of 2015. Its operating profits rose just $179 million, a total gain of 5% over the total from 2012. Its operating margin, excluding fuel costs, actually declined from 41% to 39%.

Those numbers point to Southwest's big challenge: It's not yet adding enough business travelers to its fare mix. From the first half of 2012 to the same period in 2015, Southwest's average passenger fare increased just 6%, to $158, even though it was adding longer flights to lure business customers.

Meanwhile the network carriers are closing the profitability gap. For the first six months of 2015, Delta's 19.3% operating margin virtually matched Southwest's. In the past Southwest typically enjoyed a seven-percentage-point advantage in operating margins on its domestic business. But in recent years, according to a study by Barclays, that edge had shrunk to about two percentage points.

Kelly revealed his general targets for business travel to *Fortune,* and they're ambitious. He wants to raise the portion of business customers on Southwest from 35% to around 40% over the next five years, moving it closer to the traditional airlines' fifty-fifty ratio. Kelly also thinks Southwest can lift its "load factors," the percentage of seats occupied on the average flight, from today's record 84.6% to 90% over the same period. By *Fortune*'s calculation, that combination would raise the average number of nondiscount passengers on a 175 seat 737-800 from 52 to 63 and enormously increase a flight's profitability.

GIVEN THE SHIFTING landscape in air travel, Kelly's gambit makes sense. The central issue for Southwest is how to adapt its basic product—whether it can provide the upscale perks that will lure business passengers from, say, Delta or American and not alienate its loyal customers.

In the past several years Southwest has invaded half-a-dozen major airports it had previously shunned, including Reagan National near Washington, D.C., LaGuardia and Newark in the New York

GRAPHIC SOURCE: SKYWRITER AVIATION

City area, and Logan in Boston. To fill more seats, Southwest is also echoing the majors by offering far more connecting flights through such hubs as Midway in Chicago and BWI outside Baltimore. In general, the longer the flight, the greater the competition. At the major East Coast airports that Southwest has invaded, that's precisely what it's facing.

The most notable example is Southwest's showdown with Delta at the world's busiest airport, Hartsfield-Jackson in Atlanta. Southwest purchased AirTran in 2011 to gain a foothold in that crucial market. AirTran used Atlanta as its hub, connecting passengers to dozens of small cities. Now Southwest has converted many of AirTran's flights to nonstop routes to major cities such as Houston, Denver, and Los Angeles in an attempt to steal Atlanta-based business travelers from Delta.

So far, however, Delta is winning the contest. It still controls around 80% of the seats sold in Atlanta and hasn't yielded much to Southwest on routes where the two airlines compete. For flights from Atlanta to Denver, a Southwest stronghold, Delta sells 50% of the seats, more than twice Southwest's share. And the picture is similar for service to Phoenix, Houston, and Los Angeles. In Atlanta, according to Barclays, Southwest's revenues for each seat it flies are 17% below its big-city average, and its sales growth in Atlanta lags well behind Delta's. But Southwest, says Kelly, is only beginning to exploit Atlanta's potential. "Atlanta is a developing market," he says. "It will improve significantly over time."

On leisure routes, Southwest has for decades won customers by sharply lowering fares. Its latitude for dramatically underpricing the competition is more limited on long flights, because the farther it flies, the less cost advantage it enjoys.

So Southwest is relying on a couple of longstanding strengths to attract road warriors: its fee-free bookings and ultra-friendly customer service. Southwest is the only airline that charges neither for checking bags nor for changing a ticket. If a business traveler checks two bags on a roundtrip flight, he or she typically pays an extra $200 on most airlines. On Southwest those suitcases fly for free. In fact, for customers who drop off even one bag, Southwest offers the best deal 60% of the time, rising to 88% for two bags, according to corporate travel consulting firm Topaz International. Customers can also change a ticket at no extra charge or, if they cancel a flight, get full credit for another trip. That can be a big money saver for business travelers, who make lots of last-minute changes. Southwest has also greatly enhanced its frequent-flier program, called Rapid Rewards. Starting in 2011, Southwest was the first among the four biggest airlines to award points not by number of trips or miles flown but by dollars spent, a big inducement for folks buying pricey tickets.

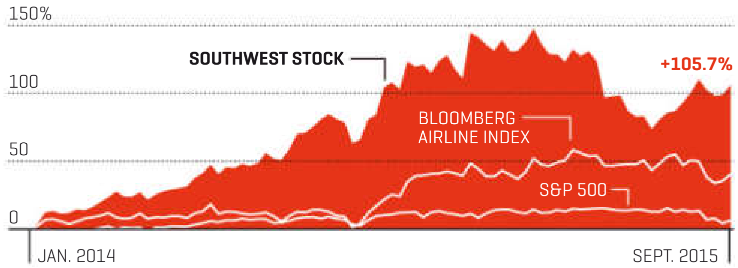
Most of all, Southwest wins loyal fans with its vaunted customer service. Abigail Johnson, co-founder of Silicon Valley public relations firm Roeder-Johnson, regularly flies Southwest from San Jose to LAX and says she mainly takes Southwest even when flying cross-country. "What I like best is the attitude of the flight attendants," says Johnson. "I've taken 1,100 flights on Southwest and maybe met two or three flight attendants who were unpleasant. On other airlines you hear them complaining all the time."

Big smiles are wonderful but maybe not enough. While Southwest is radically changing its strategy, it's only tweaking its service for business customers. Southwest's model was originally designed for travelers who pass quickly through airports, not road warriors who practically live in them. The airline doesn't provide first-class cabins or airport lounges. Nor does it offer assigned seats. All the rows are the typical coach three-across configuration, and all the seats are the same. Customers who pay the highest Business Select fares get to be among the first 15 to board. But many business passengers get stuck in the classic Southwest "cattle call" boarding process and must scramble to get a window or aisle seat.

By contrast, the network carriers' core franchise is long-haul business travel. Business travelers may hate the delays, the sometimes rude service, and the packed planes, but they keep coming back for the key perks. For the trip from Atlanta to LAX, an executive flying business class with Delta can first phone customers from the Sky Club lounge while waiting to board, then slide into a lush, two-across seat onboard with plenty of room to deploy his laptop.

STILL FLYING HIGH

Southwest was the best-performing stock in the S&P 500 in 2014, with a 122% gain, and has long been a Wall Street favorite. But its shares dipped in the spring after its expansion plans helped spark fears of a coming price war.



GRAPHIC SOURCE: S&P CAPITAL IQ

It's certainly possible that Southwest will, for the first time, offer the type of premium seating JetBlue recently introduced with its Mint product. But for now Kelly says he has no plans to change a model that has always thrived on simplicity. If Southwest does offer first-class cabins, it will win higher fares but also make sacrifices. For example, travelers on commuter routes won't pay a premium for first class, yet the planes will offer fewer seats because first class takes more space. If Southwest goes with two types of planes—one with first class, one without—it will lose the flexibility to quickly substitute one aircraft for another on any route.

EVEN AS SOUTHWEST WRESTLES with these strategic questions, it's pushing into another new frontier: international travel. Southwest is going abroad for the first time in its history. It was the AirTran purchase that gave Southwest a base of foreign routes. Now Kelly is building international into a major growth engine with an aggressive expansion in AirTran's prime overseas market, Latin America. The region is one of the world's fastest-growing air-travel destinations, yet competition on routes from the U.S. remains muted. Today the biggest U.S. hub serving Latin America is United's operation at Houston International. United currently holds an ultra-powerful position on nonstop flights to Mexico City, Costa Rica, and other prime destinations.

Going international is another way to woo business travelers. The legacy carriers enjoy an especially wide advantage over Southwest in corporate deals with *Fortune* 1,000 companies. "Those large multinationals want access to a global network," says Bob Brindley, a principal at Advito, a firm that advises corporations on managing their travel. "It's a big component of what they require. The Big Three offer that, and Southwest doesn't." Kelly is trying to close that gap.

Southwest is preparing to challenge United in Latin America by opening a new $156 million international terminal at Hobby Airport, his airline's Houston base. Kelly says he will slash fares to Latin America from Houston by about 40%. By 2020, says Kelly, Southwest could serve as many as 50 cities in Central America and northern South America. By *Fortune*'s estimates, Southwest could capture 5% of the nearly $60 billion projected market for travel to Latin America and the Caribbean, adding $3 billion in revenues. That alone would lift Southwest's projected growth rate from 5.5% to well over 7%.

There's another growth opportunity for Southwest that's much closer to home: Love Field. Until the early 1970s, Love Field was the principal airport for the city of Dallas; President Kennedy's fateful final flight landed there in November 1963. When the cities of Dallas and Fort Worth unveiled their plan for the new DFW in the early 1970s, a major condition was to shutter Love Field, which was slated to become a public skating rink.

All the other airlines agreed to move, but Kelleher refused to budge. Southwest won a famous case—upheld by the Supreme Court—that granted it the right to stay. But its rivals succeeded in persuading Congress to pass a law, known as the Wright Amendment, that severely restricted where Southwest could fly from its home-base airport. The Wright Amendment restricted direct flights by large planes from Love Field to just the four states bordering Texas, a list later extended to include three more nearby states. The airline could fly its 737s to Little Rock and Tulsa, but nonstop flights from Dallas to the big business markets such as New York City and Los Angeles were strictly off-limits.

The rules were particularly galling because Southwest's identity is closely intertwined with Love Field: Its corporate logo is a heart, and its stock ticker is LUV. Upon becoming CEO in 2004, Kelly immediately made it his mission to kill the Wright Amendment. "It was a ridiculous restriction," says Kelly. "Short haul was shrinking fast. We needed to fly to the big business centers from Dallas." In 2006, Congress voted to repeal the Wright Amendment—effective October 2014. So as of late last year, Southwest has finally been free "to move about the country" without restrictions.

For many business travelers, Love Field is far more convenient than DFW. It's just a few miles from the wealthiest enclaves in Dallas, including gilded Highland Park. Southwest has expanded from 120 to 180 flights a day at Love Field and added service to 34 cities, including such prime business destinations as Denver, Reagan National, and LaGuardia. Those flights are now over 90% full. And even though it's charging low introductory fares for the routes, Southwest is already reaping some of the best margins in its entire network.

At Southwest's headquarters across the highway from Love Field, a prized ritual is gathering for Monday afternoon "landing parties" on the roof. Employees sip beers while watching Southwest planes touch down at Love Field and hold up signs rating the pilot's performance from 1 to 10. Kelleher himself is even known to appear from time to time, a tumbler of Wild Turkey in hand. The colorful co-founder's presence is a reminder of his airline's glorious past. But under Kelly's leadership it is attempting a daring change in course. It's up to Kelly to deliver a 10 of his own—a smooth landing proving that Southwest isn't merely middling, but still the best.

WHILE YOU WERE OUT

The Wisdom of Relative Youth

What can we learn from successful people under age 40? They're just as vacuous and hedonistic as the rest of us, only better looking. *By Stanley Bing*

IN THIS ISSUE we celebrate a number of individuals who have the distinction of being under the age of 40. Of course, they've achieved other things as well, but first and foremost it does behoove us to recognize that achievement.

Being under 40, although it presents its own challenges, is also quite wonderful compared with other options. For men, it means that whatever your hair has done so far, it's not as bad as it's going to get. The women in this group are also likely to look and feel pretty good compared with their projected status in a couple of decades.

There's also the fact that when you are not yet 40, you can still tell yourself a whole lot of nice things about your future prospects and still believe some of it. If things are going well, you can legitimately think that things are going to get even better. If they're not, there's still time to read a host of inspirational, religious, and/or business books and change your game. That's completely different from being under, say, 50, which is not the new 40, no matter what they say. And forget about being under 60. That's over before you know it, with all the pertinent implications.

How about these particular under-40s? Not only are they still in the full flush of life as we know it, but they have each done something or other that has gotten them noticed and, quite possibly, rich. Being rich before 40 is even more fun than being rich after it, because you still have an impressive capacity to do something with all that gooey wealth. Being rich after 40 is good too, mind you, but you don't see people spending a lot of time celebrating you for it. In fact, there's a fair amount of annoying criticism attached to being loaded and old these days, though it still beats the alternative.

Who, then, are these creative, bold, sassy, gutsy, lucky, relatively youngish people who have achieved so much in so little time? They are, quite simply, the harbingers of tomorrow, moving fast down the highway to replace yesterday's harbingers, who are still doing quite well, although perhaps doing less harbingering than before. Some have started startups that have started up better than those that, though they started up well, subsequently stopped. Others have nurtured an idea into the full splendor of SWR, or "success without revenue"—a consummation most keenly envied by those of us who must report meaningful EPS each quarter. Others slashed through convention and found new solutions while working at a desk that is also a treadmill, and nobody was allowed to say they looked silly. And then there's Taylor Swift, whose concerts are attended by little girls in tutus, their older sisters, and their grandmothers. Take that, demographic targeters!

What can we learn from them?

They're aggressive and make their own ways. They don't care a fig about established protocols. They are rebellious and disruptive right up to the moment there's a chance that they will be the ones to get disrupted. And when they get rich, they live as stupidly and hedonistically as possible. In short, they are just like you and me, only better looking.

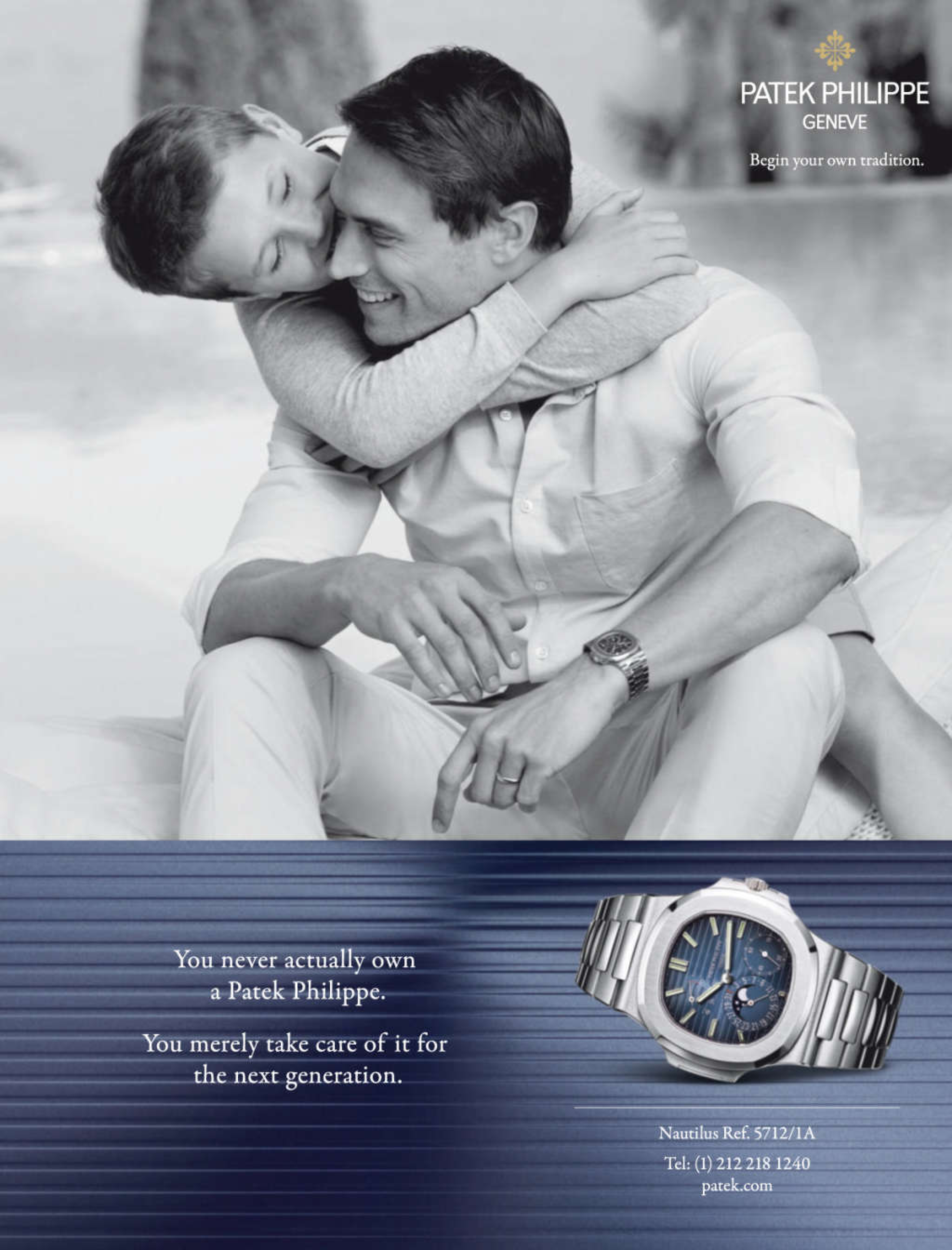
In closing, it would be appropriate, I think, to give a nod to those under 40 who are not mentioned elsewhere—the men and women laboring each day in tiny cubicles, grabbing breakfast, lunch, and dinner from the fancy company cafeteria where all the food is provided for free as long as you eat it fast and get back to your 16-hour workday; who travel in coach from Schenectady to Seattle selling inventory just as their daddies did (only it better be done faster); who don't have to worry about losing their pensions, because there aren't any long-term benefits for jobs that age out at 30.

Good luck, unsung under-40s! Sure, life's just a little bit tougher and weirder and less private than it was in the past. But, hey, at least you're still pretty young. That counts for plenty, believe me. I'd trade a lot to be able to stay up until 4 a.m. without falling asleep with my face in the bean dip. And you don't need to be on any annual list to enjoy that, right?

Follow Stanley Bing at stanleybing.com and on Twitter at @thebingblog.

ILLUSTRATION BY GUY SHIELD

Fortune (ISSN 0015-8259) is published monthly, with extra issues in March, June, September, and December, by Time Inc. Principal office: Time & Life Building, Rockefeller Center, New York, N.Y. 10020-1393. **U.S. subscriptions:** $22.00 for one year. Canada Post Publications Mail Agreement No. 40110178. Periodicals postage paid at New York, N.Y., and at additional mailing offices. Return undeliverable Canada addresses to: Postal Stn A, P.O. Box 4321, Toronto, ON, M5W 3G8. GST #888381621RT0001. Member, Alliance for Audited Media. **POSTMASTER:** Send address changes to Fortune, P.O. Box 30604, Tampa, Fla. 33630-0604. **Customer Service and Subscriptions:** For 24/7 service, please use our website: www.fortune.com/customerservice. You can also call 1-800-621-8000 or write to Fortune at P.O. Box 30604, Tampa, Fla. 33630-0604.


PATEK PHILIPPE
GENEVE
Begin your own tradition.
You never actually own a Patek Philippe.
You merely take care of it for the next generation.
Nautilus Ref. 5712/1A
Tel: (1) 212 218 1240
patek.com